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PROPOSALS FOR A REFUSE DISPOSAL SYSTEM IN OAKLAND COUNTY, MICHIGAN

Bureau of Solid Waste Management
Cincinnati, Ohio

1970

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Proposals for a Refuse Disposal System
IN OAKLAND COUNTY, MICHIGAN

Final Report on a Solid Waste Demonstration Grant Project

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II

FOREWORD

ACUTE PROBLEMS in solid waste management usually occur in high density urban centers, and nowhere are their effects more apparent. However, small towns or rural areas are also faced with difficult technical and economic problems related to collection and disposal of refuse. These smaller communities often find it hard to provide efficient, economical management of solid waste, because they cannot achieve the necessary economy of scale.

Grants to State and interstate agencies for planning for solid waste management have been aimed at solving such problems for communities—both large and small—by developing needed data and by encouraging all communities to approach the problems on a regional basis. The present publication documents the results of a planning study, which was made for a smaller community and was supported by a State planning grant. The project included plans for developing, constructing, operating, and maintaining a comprehensive program of refuse disposal. The investigation covered such areas as secondary transportation, incineration, residue disposal, rural collection and disposal, as well as legal, financial, and public information aspects. The cooperative efforts with two other counties were appraised. Only through this kind of careful planning, and cooperative effort, can we hope to meet the growing crisis of solid waste management in all the communities of this Nation.

—RICHARD D. VAUGHAN, *Director*
Bureau of Solid Waste Management

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SUMMARY AND RECOMMENDATIONS

The results of a study and investigation leading to a solid waste disposal plan for Oakland County are documented in this Report. The proposed plan for Oakland County conforms in general to Plan II of the Detroit Metropolitan Area Regional Planning Commission Report of 1964. The concept of several large incinerators located in the populous portion of the County has been retained but service area boundaries have been adjusted as needed. The Oakland County report and the recent Wayne County study propose plans that, when implemented, will serve much of the population of the Metropolitan Area. There is no conflict between the reports, and the Oakland study indicates the possibility of inter-county cooperation for residue disposal. The study has explored the various aspects of Solid Waste disposal including incineration, residue disposal, secondary transportation, and rural problems. No attempt was made to study refuse collection in depth.

In addition to the engineering study, the report sets forth in brief discussions information concerning legal, financial and other aspects of the total problem which will aid in the implementation of the plans presented.

Several recommendations have evolved as work was done in preparing the Report. These are itemized below.

1. Refuse disposal service must be made available to all members of the Oakland County Community: residents, businesses, and industry. Disposal of certain hazardous or hard to handle materials must be excluded for the safety of operating personnel and other citizens, but all material that can be safely and readily handled by the recommended equipment should be included in the County refuse disposal program.

2. We recommend that all governments of the County use the facilities proposed in this Report. Plan A is recommended and is able to provide for the refuse disposal needs of all members of the community including supplementary service for the Southeastern Oakland County Incinerator Authority.

3. Plan B is recommended if the Southeastern Oakland County Incinerator Authority does not wish to participate in the County program.

4. We recommend a few large capacity incinerators rather than many smaller sized ones.

5. We recommend the following construction program under Plan A:

Construction	Installed Capacity - Tons/Day	
	1970-1980	1980-1990
Incinerators		
Avon	1300	1300
Farmington	1200	1600
Independence	1500	1500
Troy	-0-	1500
Transfer Stations		
Milford	300	
Oxford	200	
Troy	850 (to be replaced by an incinerator in 1980)	

6. A residue disposal area in excess of 500 acres is recommended to be obtained in western Addison Township.

7. All sites should be acquired immediately to prevent them from being developed for other purposes.

8. Incineration of all burnable waste material originating in the County is recommended by the Report. Provision for burial of fly ash, foundry sand, construction materials, bulky items and other non-burnables is made at the residue disposal area.

9. Water wall incinerators are recommended. Water wall furnaces permit operation at high temperatures and use a minimum of excess air to accomplish thorough burning and help reduce air pollution, which is becoming of great concern to officials and citizens alike. We recommend the use of electro-static precipitators for air cleaning.

10. The use of transfer stations to supplement collection service in outlying areas is recommended. This secondary transportation system will use trucks to deliver refuse to the incinerators.

11. Transfer stations designed to allow for changing technology by providing room to incorporate advanced methods as they develop and are proven, is strongly recommended.

12. The rural areas should be served by convenience centers to substitute for sanitary landfills.

13. We recommend that Oakland County cooperate with its neighboring Counties for the disposal of incinerator residue or refuse on a contractural basis.

14. Federal funds are available to eligible local governments for demonstrations of new or improved methods of solid waste disposal. We suggest four projects in this Report which may be eligible for such grants. We recommend that the County apply for a Federal Grant before the time of construction.

15. We recommend that abandoned vehicles be removed from the streets and fields under a County Program and delivered to private automobile reduction plants.

16. Public Act 342 of 1939, the litter law, and the abandoned vehicle law require amendment to ease the tasks recommended for the County program. We recommend that the County Corporation Counsel bring the suggested amendments to the attention of the legislature.

17. We recommend that the County employ competent financial counsel to establish the financial program for all participants to the program.

18. We recommend that a public relations program be begun soon after acceptance of this Report as an effective method of communicating with the general public. A public relations specialist should be used in the formulation of a program.

19. We recommend that the program be implemented soon after this Report is accepted through the procedures listed in the Appendix.

Jones & Henry Engineers Limited

INTRODUCTION

Refuse - - -

Until recently, refuse was a subject not usually discussed in polite social conversations. Things are changing now. The newspapers are crowded with news items concerning refuse collection and disposal in New York, Memphis, Detroit, Pontiac and others of the nation's cities. National magazines such as *Fortune* and *Newsweek* have carried articles about this growing problem and there is an explosion of concern by editors, conservationists, public officials, and individual citizens over our rapidly deteriorating environment.

It is not difficult to understand that just about as much material must be taken from a community as is brought into it. Goods enter communities by way of our extensive road, rail, ship, or air transportation facilities in neat bundles and fancy packages. Wastes are taken out and disposed of with little thought. Until now, nature has covered for such a casual attitude towards waste handling through the natural destruction processes; however, man's technology is rapidly exhausting nature's generosity. Aluminum cans, non-returnable bottles, and growing numbers of plastic items do not deteriorate appreciably. Despite the millions of dollars spent annually for refuse disposal, most communities are falling behind and will face a crisis in solid waste disposal in the near future. Modern man is finding that his past approach to the problem is no longer satisfactory.

The task before us is unbounded. Solid waste disposal cannot be contained within the confines of a community any more than blight could be contained "on the other side of the tracks". Each community is a segment of our total society and no amount of rationalizing will exempt one healthy segment from the decay lurking in another. Before much progress can be made in meeting the solid waste crisis facing us, new patterns of cooperation between municipalities must emerge.

We must realize that we are subject to every tampering with our environment. We must be willing to work for quality everywhere, not just in our own backyard. The ugliness of litter in Pontiac Lake Recreation Area or the abandoned vehicles in Milford Township do not affect these areas alone, but their presence is felt also in Pontiac, Madison Heights, Oxford, and even beyond the limits of Oakland County. The challenge of the quest is awesome and the goal inspiring.

History of the Study

The quest for better refuse disposal in Oakland County accelerated in 1964 when the Detroit Metropolitan Regional Planning Commission issued its report entitled "Refuse Disposal Plan for the Detroit Region". This report contained the results of a feasibility study by the Commission Staff and offered two plans to solve the problem. The Oakland County Board of Supervisors made a long and careful study of the regional report and decided to authorize a further report before embarking upon a County program. Mr. Daniel W. Barry, Drain Commissioner, was named agent for the County under provisions of the County Public Improvement Act on October 5, 1966, and on October 11 of 1967 a contract was entered for engineering services to prepare a plan for implementing the basic findings of the regional study. Application for Federal assistance under provisions of the Solid Waste Act of 1965 was made and the Public Health Service, Department of Health, Education and Welfare, accepted the application and authorized the study to begin on August 1, 1967.

Purpose of the Study

Prior to retaining an engineer, the County decided upon incineration as the best method of refuse disposal for Oakland County which permitted this study to begin where the Detroit Metropolitan Regional Planning Commission report stopped. This report presents plans for the development, construction, operation and maintenance of a comprehensive program of refuse disposal. The work includes the size, location and type of construction for transfer stations and incinerators, requirements for air pollution control and estimates of cost. In making this study, we encountered problems beyond the original intent of the contract, so the purpose of the Report was expanded to include abandoned vehicles.

Scope of the Study

The work presented in this Report results from a thorough study of the refuse disposal problems of Oakland County. Our investigation has explored secondary transportation; incineration; residue disposal; rural problems; legal, financial and public relations aspects of the problem; and an investigation of cooperative endeavors with Wayne and Macomb Counties.

Method of Study

Various methods of operation were used to conduct this study. Information from many sources was compiled and evaluated. Data were gathered from questionnaires, telephone conversations, and personal interviews. Aerial photographs, previous reports, visitations to existing disposal sites and operations, both in and beyond the County limits, together with interviews with operating and supervisory personnel for these installations provide much of the information upon which recommendations are based. We talked with manufacturers of equipment to determine the capabilities of their product and its method of manufacture wherever possible. Computers helped determine load centers and do other mathematical work, thus allowing a more thorough study of alternatives than would otherwise be permitted. A total of 275 combinations of the municipalities was established and studied on the computer and from this evolved two plans which are presented in this Report. Financial and legal discussions were assembled with the aid of men knowledgeable in these fields. Estimates of cost and operation reflect current industry prices.

Many private or public organizations and individuals have contributed generously to this study. We list in the Appendix a more complete acknowledgement of those who have helped us with this work.

Method of Presentation

The Report is divided into several sections, each section dealing with certain aspects of the problem. There are four major divisions of the Report; introductory, general engineering information, presentation and implementation procedure for the plan, and appendix.

This introduction contains a listing of design considerations, the history of the project and the projection of anticipated needs.

The second division contains general engineering considerations. This portion of the Report includes the information on which decisions as to type of incinerator, secondary transportation, residue disposal and rural aspects of the problem were reached. Various methods of handling the problem are considered in this section of the Report and the conclusions reached upon which the recommended plans are founded.

The third portion of the Report presents the plans selected for refuse disposal throughout Oakland County and explores various related aspects of the problem. It is in this section that such information as legal, financial, public relation discussions and cooperative endeavors with Wayne and Macomb Counties are presented. These discussions, although not a direct part of the plans presented for refuse disposal in the County, will help the Board of Supervisors and their Agent in implementing the proposals.

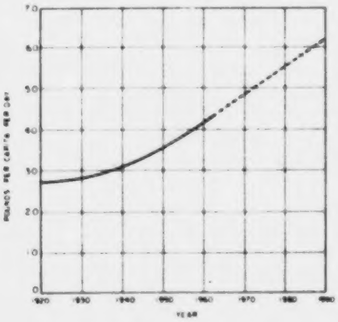
The last portion of the Report contains the Appendix in which the tables and other supporting data, not contained in the text of the Report, are presented.

DESIGN CRITERIA

Solid waste is produced by all constituents of the County community. Residences, commercial establishments and industry each make a contribution to the total refuse disposal problem. Variations of quantity occur from each of these contributors according to type and size of family or business. Quantity also varies seasonally. An average estimate of quantity contributed by each member of the community is needed for the design of facilities for the County.

Few accurate records are kept of refuse production in the County. Collection practice is diverse; individual private haulers keep few records. Salvage, by industry or through junk dealers, on-site burning and other private disposal practices cloud the picture of refuse production. Most municipalities have little knowledge of amounts of refuse collected or even the amount disposed of in terms of area, yardage or tonnage.

The Southeastern Oakland County Incinerator Authority (SEOCIA), the Central Wayne County Sanitation Authority and the Sanitation Department of the City of Detroit do keep accurate records of quantities delivered to their incinerators. The records of SEOCIA represent quantities from approximately 43 percent of Oakland County residents according to 1967 estimates by the Detroit Metropolitan Planning Commission. All records relate primarily to residential wastes but these three organizations have collected enough data to guide our estimate of the amount of solid waste produced in the County.



PER CAPITA REFUSE PRODUCTION FOR THE UNITED STATES

FIGURE 1

Nationally, the quantity of solid waste has risen steadily in the past. The curve in Figure No. 1[1] indicates the trend and the projected continuation into the future. This curve is for illustrative purposes only, because it does not represent the entire quantity of commercial and industrial material which is produced nor is it indicative of quantities that can be expected from any local area.

Several years will be required to establish a solid waste program. We have proposed the year 1970 as the first year of service, and we further proposed that facilities be designed for expansions adequate for projected loads in the year 1990.

Quantities of refuse that will be produced in Oakland County, and on which the various facilities proposed in this Report are based, have been estimated by separate consideration of domestic, commercial and industrial refuse sources.

Residential Refuse

Population data, on which estimated quantities of refuse are based, are taken from the report "The Population Growth and Evaluating Urbanization of Oakland County" by Albert J. Mayer. This report was prepared by the Oakland County Planning Commission in 1967 and covers population growth through the year 1990. The report estimates future populations by political subdivisions or combinations of subdivisions within Oakland County for the years 1970, 1980, and 1990. For purposes of estimating interim quantities, we have interpolated between the values for population given in that report. Estimates of population are tabulated in Appendix Table I.

The Southeastern Oakland County Incinerator Authority has kept an accurate record since 1955 of the amounts of refuse produced in each contributing political unit. This, together

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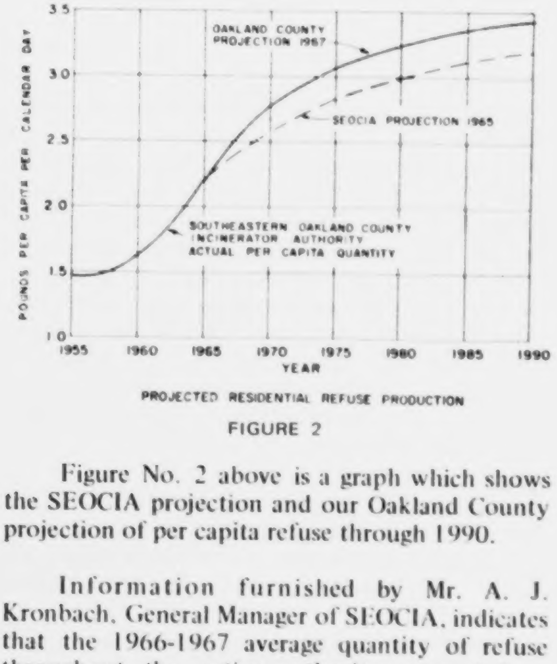
1. Reproduced with permission from *Refuse Collection Practice*, 3rd Edition, A.P.W.A., 1966

with estimated population for each political unit, has furnished a rather accurate picture of the growth of refuse production in terms of pounds per capita daily over the last 10 years. A similar series of records for members of the Central Wayne County Sanitation Authority are also available, but for a period of only 3 years.

The Southeastern Oakland County Incinerator Authority has projected the estimated amounts of refuse that will be produced per capita through the year 1995. This projection is based on historic fluctuations in refuse production from the various members of that Authority. Their prediction has been taken as the best available data for the Oakland County area. However, the age and character of housing within the authority makes their projected quantities somewhat low for the rest of the County in our opinion. The reason for this is that the homes are generally in the 10 to 15 year age bracket, the economic situation of the population is at about the low ebb for refuse production, and most of the homes are now past the period of first major appliance replacement. Our production figure per capita has, therefore, been increased over the SEOCIA figure, but the rate of increase has been kept approximately the same after 1975.



PROJECTED RESIDENTIAL REFUSE PRODUCTION

FIGURE 2

Figure No. 2 above is a graph which shows the SEOCIA projection and our Oakland County projection of per capita refuse through 1990.

Information furnished by Mr. A. J. Kronbach, General Manager of SEOCIA, indicates that the 1966-1967 average quantity of refuse throughout the entire authority amounted to 2.39 pounds per capita daily, based on a calendar day. Mr. Virgil Eller, Superintendent of the Central Wayne Authority, provided figures indicating the production in the same period for his authority at 1.84 pounds per capita per calendar day. A spot check of the records of the refuse shed of the Southeast Incinerator for the City of Detroit indicates their production of residential refuse at 2.83 pounds per capita daily.

We estimate that the quantity of refuse produced by the domestic segment of the Oakland County population will be 2.78 pounds per capita per calendar day in 1970. Actual quantities of refuse collected in the early years of the program from the rural portions of the County will probably be much less than indicated as a result of the numerous backyard burners and other private means of disposal commonly used by rural residents.

Commercial Refuse

Commercial units include retail and wholesale stores, commercial and professional offices, schools, hospitals, and other similar institutions. Most of the refuse from these sources consists of paper and paper products, but will also include food waste from such sources as restaurants and markets.

We base our estimates of quantity from commercial sources on the number of square feet of floor area devoted to commercial use in Oakland County. In 1964 a survey was made by the Oakland County Planning Office in which floor area for various commercial buildings was listed and classified. Current estimates of commercial floor space are based on figures obtained in the 1964 survey and are increased in proportion to the population for purposes of projecting to the year 1990. Our estimates of commercial floor space in Oakland County appears in the Appendix Table II.

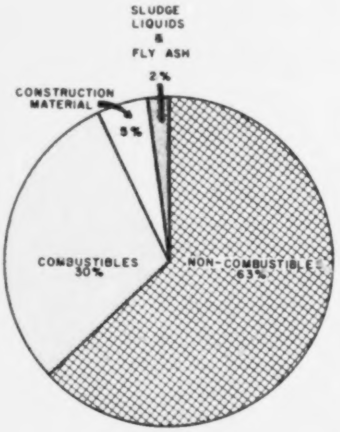
The amount of commercial refuse production varies considerably. Seasonal fluctuations as well as differences among types of businesses create these variations. We were unable to locate existing records which would indicate average daily commercial refuse yield. Our estimates are based on refuse produced by various commercial establishments. We estimate a projected figure of 0.01 pounds per square foot of building area per day in 1970. We have estimated that the rate of commercial production will increase at the rate of approximately 1-1/4% per year, so that commercial production will approach .0126 pounds per square foot per calendar day by 1990. These figures represent a quantity of commercial refuse equivalent to 0.97 pounds per capita daily in 1970, and 1.45 pounds per capita daily in 1990, based on projected population figures.

Industrial Refuse

Questionnaires were sent to 1338 industrial firms doing business in Oakland County. Of these, 177 were reclassified as commercial firms based on their replies, and 77 were either no longer in business or were located outside Oakland County. The remaining 1,084 firms provide the sample on which the industrial refuse load was computed. Of the 1,084 firms, replies were received from 650, of which usable data was contained in 516 replies, representing about half of the firms operating in Oakland County. Telephone contacts with representatives of several firms indicated that those who did not reply probably produced refuse equivalent to that expected from residential type operations. Accordingly, we have assumed that data contained in the 516 replies represent 90% of the total industrial refuse production in the County of each classification. Loads used elsewhere rely on this assumption.

We believe that the data received from the replying industries are representative of the industrial solid waste production current in Oakland County. In several instances data were provided from company records, and in others plant surveys of varying duration were conducted before returning the questionnaires. However, it must be noted that no historic data are available on which to project estimates of future industrial solid waste production. This lack increases the uncertainty of projections of refuse from industrial sources through 1990.

Data returned on the questionnaire were divided into several classifications of refuse, including garbage and combustibles, non-combustibles, construction material, fly-ash, sludges, volatile liquids and non-volatile liquids. The breakdown is shown on the pictograph, Figure No. 3.



CLASSIFICATION OF INDUSTRIAL WASTE PRODUCTION
FIGURE 3

The industrial load which could be expected at a disposal site was computed as follows:

> All garbage and combustible material and one-half of the non-combustible material, exclusive of fly-ash, foundry sand and construction material, were assumed to reach the disposal site. The remainder of the non-combustible refuse was assumed as salable material which would be salvaged by the company producing it. Fly-ash, foundry sand, and construction materials are items that would be disposed of by landfill and were considered separately from other non-combustibles for the purposes of disposal. Only a very small portion of the volatile liquid and probably none of the non-volatile liquid solid waste from industrial sources would reach the disposal sites of Oakland County since most of this material is sent to commercial firms in Detroit for reclaim, salvage or disposal according to replies from questionnaires.

We assume that industrial refuse quantities will increase at an approximate rate of 2% per year between 1970 and 1990. Our estimates of the amount of industrial waste which will reach the disposal sites, exclusive of foundry sand, fly-ash, and construction materials will represent 1.46 pounds per capita daily in 1970, and will reduce to 1.23 pounds per capita daily by 1990.

Estimated Quantities

The quantity of solid waste generated in Oakland County will increase in the future. The increase will result from both increasing population and increasing use of pre-packaging and throw-away containers by both commercial and industrial firms. Efforts will be made to restrict the production of throw-away containers and the acceleration in the use of convenience packaging will probably diminish in the future. However, it is unlikely that the rate of increase in the per capita refuse production will be reversed. The increase in the per capita solid waste production will be further augmented by more stringent restrictions on open burning. It is likely that the amount of incinerable solid waste contributed per capita will increase to in excess of 6 pounds daily within the next 20 years. This will be in addition to the unburnable materials produced by the commercial and industrial sources within the County.

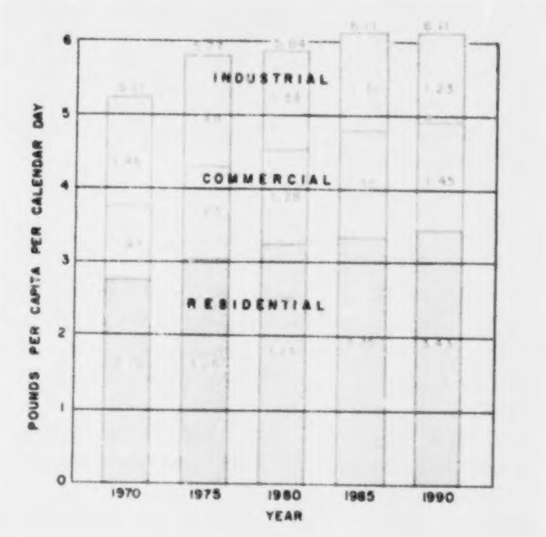
We estimate the following quantities of solid waste material will be produced in Oakland County between 1970 and 1990:

Type of Refuse	Year	Daily Quantity (Calendar Day) Tons *	 CY **
Residential	1970	1320	
	1975	1780	
	1980	2070	
	1985	2390	
	1990	2750	
Commercial	1970	510	
	1975	680	
	1980	840	
	1985	1010	
	1990	1180	
Industrial	1970	770	650
	1975	820	670
	1980	870	680
	1985	920	690
	1990	960	710
Totals:	1970	2600	
	1975	3280	
	1980	3780	
	1985	4320	
	1990	4890	

* Normally Handled Refuse

* * Bulk Items and Hazardous Materials

A graphical representation of the amounts of refuse produced in each design period is shown by Figure No. 4.



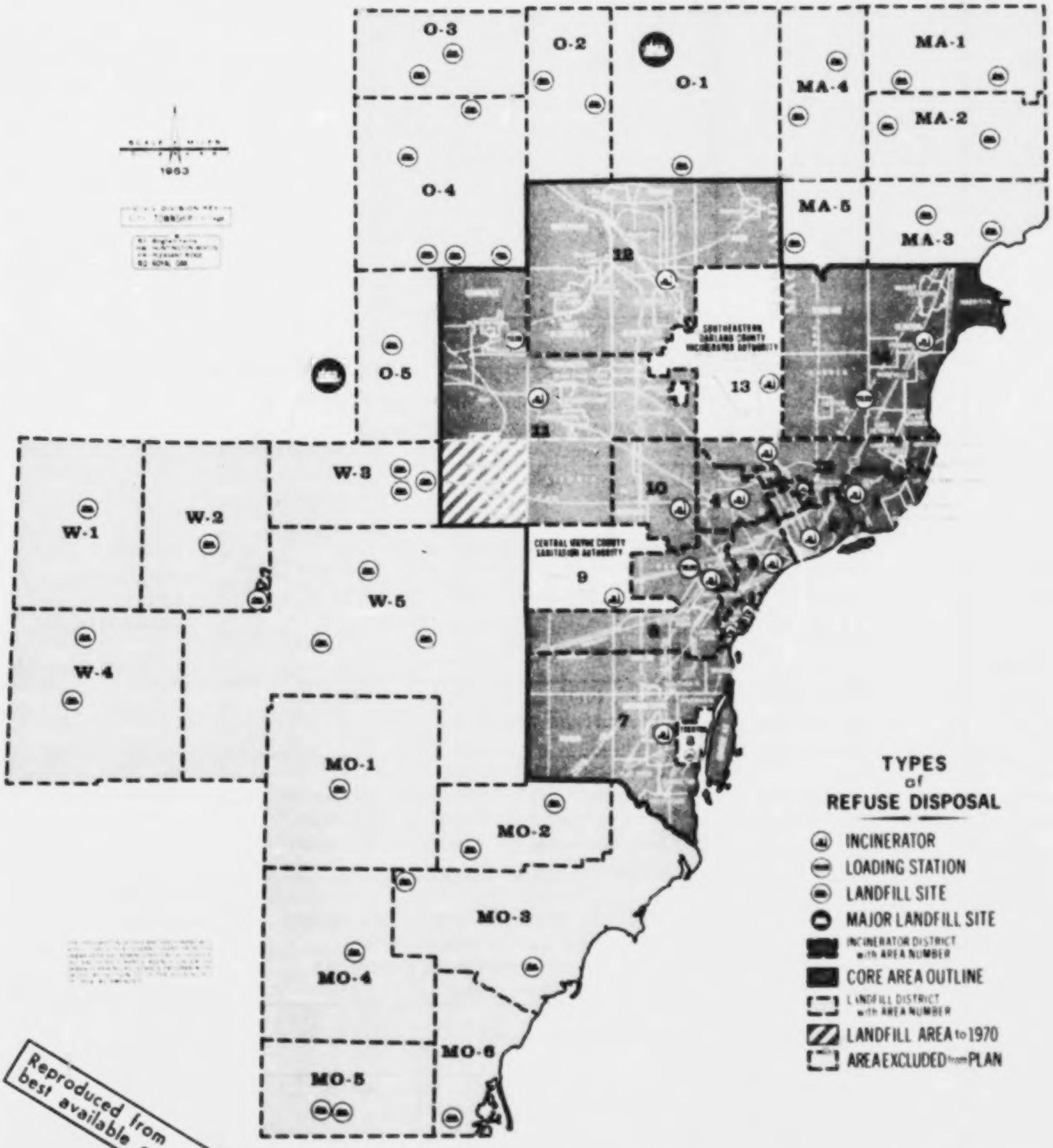
ESTIMATED INCINERABLE
REFUSE PRODUCTION

FIGURE 4

Two plans were selected for further study and investigation upon completion of the preliminary study, one to offer county facilities to relieve the load on the existing SEOCIA incinerator in Madison Heights, the other to exclude the SEOCIA entirely. These two plans are discussed in greater detail later in the Report.

Neither of the two plans selected corresponds to the plan established in the Detroit Metropolitan Area Regional Planning Commission Report of 1964. Developments since that report was published, including the detailed Wayne County study, necessitate changing some of the refuse disposal area boundaries. This change in boundaries allows the service areas of Oakland County facilities to stop at the County line. The plate on the following page, reproduced with permission, shows Plan II of the Detroit Regional Report as it was originally proposed.

PLAN II REFUSE DISPOSAL / IN THE DETROIT REGION


O-3
O-2
O-1
MA-4
MA-1
MA-2
O-4
MA-5
MA-3
12
SOUTHEASTERN OAKLAND COUNTY INCINERATOR AUTHORITY
13
O-5
11
W-3
10
W-1
W-2
CENTRAL WAYNE COUNTY SANITATION AUTHORITY
9
W-5
W-4
7
8
MO-1
MO-2
MO-3
MO-4
MO-6
MO-5
1963
TYPES of REFUSE DISPOSAL
INCINERATOR
LOADING STATION
LANDFILL SITE
MAJOR LANDFILL SITE
INCINERATOR DISTRICT with AREA NUMBER
CORE AREA OUTLINE
LANDFILL DISTRICT with AREA NUMBER
LANDFILL AREA to 1970
AREA EXCLUDED from PLAN

Reproduced from best available copy.

Classification of Refuse Materials

Refuse (Solid Wastes)	Garbage	Wastes from the preparation, cooking, and serving of food Market refuse, waste from the handling, storage, and sale of produce and meats		From: households, institutions, and commercial concerns such as: hotels, stores, restaurants, markets, etc.
	Rubbish	Combustible (primarily) organic)	Paper, cardboard, cartons Wood, boxes, excelsior Plastics Rags, cloth, bedding Leather, rubber Grass, leaves, yard trimmings	
		Noncombustible (primarily inorganic)	Metals, tin cans, metal foils Dirt Stones, bricks, ceramics, crockery Glass, bottles Other mineral refuse	
	Ashes	Residue from fires used for cooking and for heating buildings, cinders		
	Bulky Wastes	Large auto parts, tires Stoves, refrigerators, other large appliances Furniture, large crates Trees, branches, palm fronds, stumps, flotage		From: streets, sidewalks, alleys, vacant lots, etc.
	Street refuse	Street sweepings, dirt Leaves Catch basin dirt contents of litter receptacles		
	Dead animals	Small animals: cats, dogs, poultry, etc. Large animals: horses, cows, etc.		
	Abandoned vehicles	Automobiles, trucks		
	Construction & Demolition wastes	Lumber, roofing, and sheathing scraps Rubble, broken concrete, plaster, etc. Conduit, pipe, wire, insulation, etc.		
	Industrial refuse	Solid wastes resulting from industrial processes and manufacturing operations such as: food-processing wastes, boiler house cinders, wood, plastic, and metal scraps and shavings, etc.		From: factories, power plants, etc.
	Special wastes	Hazardous wastes: pathological wastes, explosives, radioactive materials Security wastes: confidential documents, negotiable papers, etc.		Households, hospitals, institutions, stores, industry, etc.
	Animal and Agricultural wastes	Manures, crop residues		Farms, feed lots
	Sewage treatment residues	Coarse screenings, grit, septic tank sludge, dewatered sludge		Sewage treatment plants, septic tanks

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FIGURE 5

Solid Waste Characteristics

It is necessary to know the characteristics of the material handled to prepare a suitable plan of refuse disposal.

Domestic and commercial refuse is composed primarily of paper and paper products with quantities of garbage, grass clippings, plastic, glass, metal, and various other materials. A general analysis of a composite municipal refuse as shown in the following table represents an average taken from several sources.

Corrugated Cardboard	7%
Newspapers	14%
Miscellaneous Papers	25%
Plastic Film	2%
Leather, Molded Plastic & Rubber	2%
Garbage	12%
Grass, Leaves and Dirt	10%
Textiles	3%
Wood	7%
Glass, Ceramics, and Stone	10%
Metallics	8%

Seasonal variations occur in refuse characteristics. For instance grass or leaves can account for more than 30% of the total quantity during some seasons.

A generalized classification of refuse material appears in Figure No. 5 on the preceding page.

The density of refuse is variable with degree of compaction, moisture content and its constitution. Normal refuse weighs about 100 to 150 pounds per cubic yard at the collection point. When placed in a collection truck and compacted the density will range from 250 to 450 pounds per cubic yard. In compactor transfer vehicles the density will be 500 to 600 pounds per cubic yard. In the storage pit of an incinerator densities of 325 to 450 pounds per cubic yard are common and in sanitary landfills densities of 700 to 1000 pounds per cubic yard can be achieved after thorough compaction.

When municipal refuse is burned in an incinerator plant, the volume of material is greatly reduced. Residue leaving the incinerator may have as little as 15 to 20% of the original volume and will weigh about 30 to 35% of its original weight. The density of residue is approximately 1,000 pounds per cubic yard.

A large amount of heat release accompanies incineration. Heating value of refuse received at an incinerator varies between 3500 and 6000 BTU per pound, depending upon moisture content and relative composition. Increasing quantities of paper and high BTU content of plastic materials appearing in refuse, together with decreasing proportions of garbage, will cause the average BTU content of refuse received at an incinerator site to increase from approximately 4500 BTU per pound to 5500 BTU per pound over the design period.

Air Pollution Control

The Michigan Air Pollution Control Act, Public Act 348, 1965, has authorized the State Health Department to formulate rules and regulations governing the characteristics of emissions from burning devices. Under these regulations the density of smoke discharge is limited, so that the maximum amount of particulate matter leaving the stack of a municipal incinerator shall not exceed 0.30 pounds per 1,000 pounds of stack gas corrected to 50% excess air. Such emission standards will require sophisticated types of air pollution control devices on any furnace stack.

The trend toward more and more control of the environment is evident from recent legislation. Efforts to control air pollution have increased greatly in the past few years. Emissions from municipal incinerators are expected to become more rigidly controlled in the future, and discharges permitted in the current rules and regulations will probably be reduced in the future.

All incinerators recommended in this Report should be equipped with the best available air pollution control equipment capable of meeting or exceeding present State standards.

Water Pollution Control

Refuse buried in sanitary landfills is a potential source of ground and surface water pollution. End products of decomposition – carbon dioxide and water – can combine to increase hardness, dissolved solids, and chemical pollution in any water they reach. Toxic chemicals in waste present the greatest hazard to water supplies. For this reason, sanitary landfills are required to be isolated from ground and surface waters by a minimum of 2 feet of earth.

Residue from incinerators seldom has been burned completely enough so that it can be placed on the open land for disposal. Sanitary landfills are required for disposal of most incinerator residues because of the unburned material which they contain. Normal precautions against water pollution must be followed at the residue fill.

Water for quenching ashes in an incinerator unit and for trapping fly-ash must be recirculated or treated to prevent water pollution. This waste water must be treated by a suitable sewage system contained within the plant itself, or disposed of through a municipal sewage system.

Water Supply & Sewerage

Wherever incinerators are used in the refuse disposal program, an adequate supply of water for cooling gases and for quenching ashes or for potable uses must be available. Sites selected for the incinerators proposed in this Report have been studied for the availability of a water supply through the Detroit Metropolitan Water Development Program, and/or for a privately developed water supply for use in the incinerator installation.

Likewise, incinerator locations have been selected near existing sewer systems or sewer systems proposed under the Pollution Control Program of the Department of Water Supply, City of Detroit. This program is far-reaching and extends into Oakland County, with planned completion dates for construction extending to the year 2000. However, a great portion of the County is either now or expected to be served under the system by 1975.

Wind Conditions

Wind has an important effect on the selection of solid waste disposal sites. Wind direction should be considered when trenches or cells are established at sanitary landfills, as well as when selecting a site for an incinerator. Inasmuch as little wind information is readily available in Oakland County, we include the following listing. Data on the prevailing winds were obtained from the U.S. Department of Commerce Weather Bureau for the Wayne-Oakland County area.

Annual Percentage Frequencies
of Wind Direction and Speed

	Flint		Detroit	
Direction	% Time	Speed MPH	% Time	Speed MPH
N	4.1	8.6	10.0	8.9
NNE	3.0	9.4	4.0	8.5
NE	3.7	9.1	4.0	8.0
ENE	4.3	8.7	4.0	8.9
E	4.2	8.1	6.0	7.8
ESE	3.8	8.9	4.0	8.5
SE	3.9	8.3	5.0	7.6
SSE	4.6	9.4	3.0	8.3
S	7.6	9.5	10.0	8.9
SSW	9.3	10.2	5.0	11.0
SW	10.9	10.0	9.0	12.3
WSW	10.2	10.7	6.0	12.9
W	6.6	10.3	9.0	12.3
WNW	7.2	10.6	8.0	13.9
NW	5.6	9.1	9.0	11.5
NNW	4.5	8.9	4.0	11.3
CALM	6.5		1.0	

HISTORICAL CONSIDERATIONS

Since World War II the character of much of Oakland County has changed. The Southeastern quadrant is now highly developed with residential communities. The search for suburban living is, at this moment, carrying prospective home buyers into the more rural areas of the County, including parts of Brandon, Independence, Oakland and Holly Townships. Despite this increase in the population density, the responsibility for solid waste disposal rests largely upon the individual.

In rural areas invidivual home owners dispose of their refuse through backyard burning, burial, or by hauling to a disposal site. Many subdivisions and some scattered rural homes have the services of a private refuse hauler. Private haulers also furnish the only refuse collection service in many of the villages and cities in Oakland County. Several densely populated areas in the southeastern corner of the County use private haulers contracting directly with the community for refuse removal; and in several instances, municipal forces are used. The problem has been to find a place to properly dispose of the unwanted waste material.

Southeastern Oakland County Incinerator Authority

The Southeastern Oakland County Incinerator Authority represents the efforts of several communities to overcome the disappearance of suitable low-cost disposal sites within a reasonable distance. An incinerator with rated capacity of 450 tons per day was put into service in 1955, and rebuilt to a capacity of 600 tons per day in the early 1960's. Today, this facility near John R. and 12 Mile Road in Madison Heights is overloaded by the waste produced by the 14 member communities. The municipalities now comprising the authority are: City of Berkley, Village of Beverly Hills, City of Birmingham, City of Clawson, City of Ferndale, City of Hazel Park, City of Huntington Woods, City of Lathrop Village, City of Madison Heights, City of Oak Park, City of Pleasant Ridge, City of Royal Oak, Township of Royal Oak, and City of Troy.

Site Availability

Suitable land for solid waste disposal continues to become scarce as urbanization encroaches upon rural areas of the County. The problem is no less acute in rural areas as a result of sites for solid waste disposal being discouraged by zoning regulations. Thus, in the greater portion of Oakland County, land legally and geographically well-suited to solid waste disposal is difficult to find.

The concern of the public is aroused by an activity which it believes will endanger the County's resources or create a nuisance. The active protests to proposed locations of solid waste disposal sites in several areas in the County demonstrate this concern.

Opposition to Solid Waste Disposal

The subject of refuse disposal is one that arouses the emotions of Oakland County residents. So strong is the public attitude against refuse disposal that in 1966 and 1967, an adamant group in Waterford Township blocked the construction of a private sanitary landfill which would have been approximately 2,000 feet from the nearest lake, [illegible]2 feet above ground water elevation, was isolated from homes on three sides by public lands and on the fourth side by an industrial area, and was intended to be run according to the best technology available. Despite favorable testimony at public hearings by officials of the Planning Commission, State and local Health Departments and by outside experts, the Township Board refused to permit the sanitary landfill operation after several public hearings which as many as 400 citizens attended to voice their objections.

In Commerce Township, officials have voted against a sanitary landfill proposed by the County Road Commission. In Troy Township, a transfer station located in an industrially-zoned area and to be operated by the Southeastern Oakland County Incinerator Authority has met with considerable resistance and the authority is receiving many objections to the operation of its

Birmingham Area News

Commission to Consider Rubbish Transfer Plan

Land-Fill Near a Showdown in Waterford

Waterford Land-Fill Controversy Is Nearing Climax

Waterford Land-Fill Debate Draws 400; Action Tabled

Commerce Twp. Vetoes County's Plans for Dump

Action Is Due on Land-Fill in Waterford

Birmingham Area News

Rubbish Transfer Station to Be Considered Again

Dump Issue Nears Climax in Waterford

Voice of the People

Proposed Land Fill Site Discussed by Readers

Waterford Planners Reject Maceday Lake Road Land-Fill Bid

See Waterford Landfill as Detriment

Site Suitable for Land-Fill —Planners

incinerator. The clippings reproduced on the opposite page attest to the general public attitude regarding sanitary landfills in Oakland County.

Indeed, zoning regulations of many cities and townships reviewed in the course of this study seem to oppose the vital public service of refuse disposal. In all but two of the Ordinances reviewed, incineration was prohibited. In six additional Ordinances, landfill was a permitted land use in certain restricted areas under special permit and review by the Zoning Board, and in two instances upon written approval of surrounding property owners within specified distances. Five of the Township Ordinances specifically prohibited any form of refuse disposal within their jurisdiction. The remaining Ordinances made no mention of solid waste disposal, neither permitting nor prohibiting such use of the land. These zoning regulations will certainly make the final site selection more difficult, and in some instances, zoning changes will be required to permit the disposal of residues and solid wastes in Oakland County.

Public Act 87

In 1965, the State of Michigan enacted Public Act 87, which required the operation of disposal sites to conform to State regulations or to be abandoned. A more complete discussion of Public Act 87 occurs later in the Report. The enforcement of Public Act 87 has prompted operators to close several sites in Oakland County. These operators did not believe they could economically convert their dumps to the desired landfills. The effect of closing disposal sites is felt most in rural and suburban townships. Some effort was made to combine rural areas into authorities for better control, such as the Pontiac-Orion Disposal Authority, which operates a dump on Kern Road. Some of these rural efforts have been in vain but urban authorities have been successful. The problem was further compounded when several private operations closed their disposal sites rather than make the changeover to the better form of refuse disposal. The effect of Public Act 87 has been to stop open burning, close sites whose owners would or could not meet the cost of operating sanitary landfills, and in some instances to convert open dumps to "sanitary landfills" in name only. However, in general, its effect has been to vastly improve the quality of solid waste disposal throughout the state.

Present Facilities

The pursuit of this study required as accurate a determination as possible of solid waste collection and disposal methods now used in Oakland County. The Detroit Metropolitan Area Regional Planning Report of 1964 provided a portion of the information used, but, a majority of the data were accumulated through field investigation, questionnaires and interviews with officials of the individual communities within Oakland County. Existing solid waste disposal sites were located on aerial photographs provided by the Oakland County Planning Commission, and then individually inspected on the ground for verification.

Collection Practices

Three types of collection practice are used in Oakland County; municipal collection, contract collection, and private collection. A brief description of each follows for those unfamiliar with the various systems.

When a municipality owns and operates the collection trucks and makes direct employment of collection crews, the system is called a municipal collection system. Supervision and direction are under a regular governmental official just as such functions as street cleaning or sewer maintenance. At the present time, six cities in Oakland County are using this form of refuse collection.

If a private individual or firm owns the collection vehicles and employs the crew, but contracts directly with the local government, the collection practice is referred to as contract collection. The contractor acts as an agent of the city in making collections, and the municipality enforces regulations and usually collects the fees for the services of the contractor. Twenty-six municipalities in Oakland County report the use of contract collection for refuse service in their communities.

Private collection is the term which refers to the system wherein the individual property owner contracts directly with a refuse collector to serve his premises. Under this system there is seldom regulation by any authority, and fees are collected by the hauler directly from the individual. Twenty governmental units in Oakland County report that private haulers provide collection of refuse within their subdivisions.

Table No. III in the Appendix entitled – "Methods and Costs of Collection and Disposal of Refuse in Oakland County" is supplemented by Table No. 3 in the Detroit Metropolitan Regional Planning Commission Report of January 1964 (Appendix Table No. IV.) A comparison indicates that twenty-five municipalities have changed the type of collection service which is offered their residents since the survey of 1961 reported in the 1964 report. In most cases, the service was upgraded from that shown in the earlier study.

Specific recommendations for methods and types of collection in Oakland County were not a part of this study; however, the method of collection has considerable influence on the selection of disposal facilities which are recommended in this Report. Approximately 70-80% of the total cost of refuse disposal on the average is spent in the collection of refuse.

Disposal Practices

Once refuse has been collected it must be disposed of in some manner. Three common types of disposal are used in Oakland County; open dumping, landfill, and incineration. These forms of disposal are practiced by municipalities, private collectors, industries, and individuals to varying degrees.

Open Dumping

Open dumping is the least acceptable method for disposal of solid waste. Open dumping is the oldest method of waste disposal used by man. It is simply to discard unwanted material as near to the place of origin as feasible. When the depository for this material is used by several individuals, it is commonly known as a dump. The characteristics of the open dump include uncovered refuse, fly breeding, seagulls, rats, open burning, blowing papers, odors, and other nuisances well known to any who have visited these places. Open dumping is the most common method of refuse disposal occuring in the United States.

Sanitary Landfill

Recently, land disposal of refuse has been greatly improved. Modifications of methods of filling land with refuse have been adopted by public health and engineering officials to control nuisances associated with the open dump.

This new method of disposal is called "sanitary landfill". Sanitary landfill involves the compaction and daily covering of all refuse brought to the site. Rats, flies, seagulls, and other vermin cannot find the landfilled refuse habitable or a source of food, and the possibility of fire and blowing papers is averted. When properly operated, a sanitary landfill can meet the highest standards of refuse disposal desired by any modern community.

Incineration

Incineration is the term applied to the controlled, confined burning of refuse within a furnace. A modern incinerator reduces the volume of refuse brought to it and discharges gaseous and some particulate matter to the atmosphere. The reduction of refuse to an ash and gas accompanies a large release of heat. The products of incineration carried in the exit gases must be removed prior to discharging to the atmosphere. The residue which leaves the incinerator is considerably reduced in volume from that received.

Existing Operations

Twenty-three communities indicated on questionnaires that they dispose of their solid waste at a sanitary landfill, seven indicated the use of open dumps, fourteen used an incinerator, and eighteen did not indicate their method of disposal. Many of these sites used by municipalities and townships are operated privately by contract collectors or private haulers. In most instances, these sites are open dumps or modifications of open dumps. Where a modification of the open dump occurs, it is usually as a result of an effort toward compliance with regulations under Public Act 87. In most instances this is limited to restrictions of open burning. Failure to cover refuse daily is often excused by mis-statements that no garbage is permitted, or that rats, flies, seagulls, and other vermin are not problems. Dumping in surface water or into the water table is still common practice at many dump sites and little or no attempt is made to control vectors. Both of these practices create nuisances and hazards to health.

The inspection of aerial photographs and subsequent ground inspections revealed several operating disposal sites in Oakland County as shown on Figure No. 6. There were thirty-nine open dumps existant at the time the photographs were made in 1963. These thirty-nine operations included known public dumping sites and promiscuous operations including roadside dumping operations in which refuse covered an area of approximately one-tenth acre or more. There are eight construction material fills located in the County. Construction fills are differentiated from open dumps by the fact that the construction fill contains no household type waste, paper or garbage. Seven disposal sites are actively operating as sanitary landfills, or making an extensive effort to comply with the regulations of Public Act 87. One piggery operates in Oakland County but will probably close operation within a year, according to its operators.

In addition to the active disposal operation in Oakland County, our investigation revealed fifty-eight closed disposal sites, of which nineteen were not closed in a suitable manner. Inadequate care in final covering is the most frequent violation.

Questionnaires to the individual communities indicate that thirty-two of the sixty-four political bodies within Oakland County now dispose of solid waste beyond their boundaries, whereas only seven have disposal sites within their political jurisdiction. The remaining twenty-five communities did not indicate where their refuse is taken for disposal. We must assume that the solid waste from the twenty-five municipalities also crosses into the territory of another political body for disposal.

Industrial Disposal Facilities

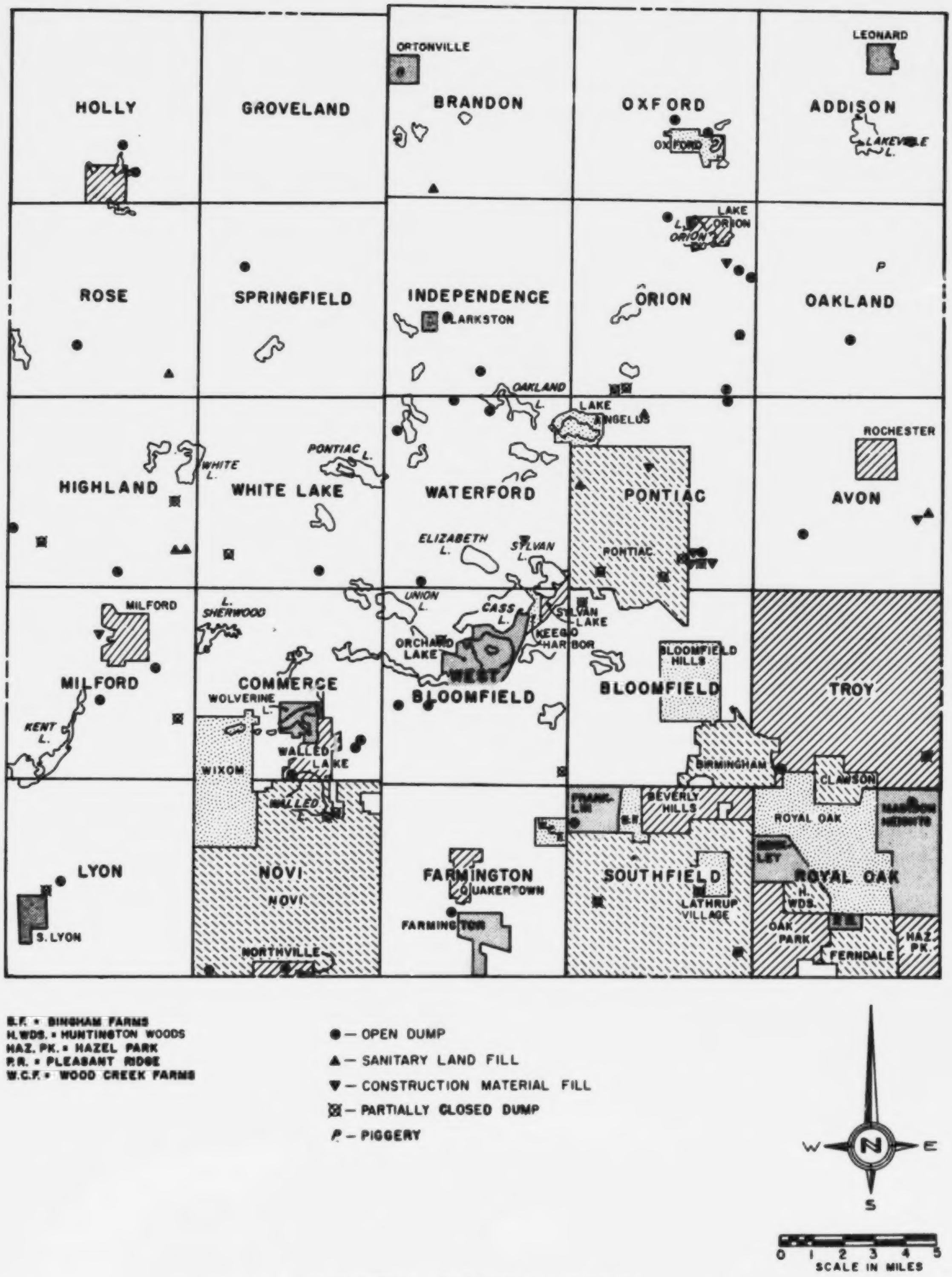
Several industries in Oakland County operate their own disposal facilities, including open dumps, landfills, lagoons, and private incinerators. The questionnaires returned by forty-four industries indicate they operate such refuse disposal facilities. Twenty-five of these forty-four industries operated dumps, eighteen reported operating landfills, and one has a private incinerator. Several of the reported sites do not fall within the jurisdiction of Public Act 87, which exempts industrial disposal areas on land contiguous to manufacturing plants.

Many of the industries of Oakland County produce liquid wastes or hazardous wastes which require special knowledge or handling for proper disposal. Much of this material is being sent by the producer to disposal operations or reclaimers located outside the County. There can be no objection to such practice provided that the final disposal does not become a health hazard through environmental pollution.

Occasionally some of the material of industrial origin remains in Oakland County. There are three disposal operations in the County receiving industrial wastes – one each in Avon, Pontiac and Rose Townships. In each case, disposal is poor and conditions are aggravated by importing industrial waste from beyond the County boundary. The local and state health departments are attempting to bring these operations to acceptable standards or to force their closure. If the disposal of these waste materials can be done in an acceptable manner, these sites will be permitted to continue operation. With specialized knowledge in handling special waste such firms can make a useful contribution to the overall solid waste disposal program.

Miscellaneous Disposal Methods

Throughout the County, open burning is


HOLLY
GROVELAND
ORTONVILLE
BRANDON
OXFORD
OXFORD
LEONARD
ADDISON
LAKEVILLE L.
ROSE
SPRINGFIELD
INDEPENDENCE
CLARKSTON
LAKE ORION
ORION L.
ORION
OAKLAND
P
OAKLAND L.
LAKE ANGELUS
ROCHESTER
HIGHLAND
WHITE L.
PONTIAC L.
WHITE LAKE
WATERFORD
PONTIAC
PONTIAC
AVON
ELIZABETH L.
SYLVAN L.
MILFORD
MILFORD
L. SHERWOOD
UNION L.
CASS L.
SYLVAN LAKE
KEEGO HARBOR
ORCHARD LAKE
WEST BLOOMFIELD
BLOOMFIELD HILLS
BLOOMFIELD
TROY
COMMERCE
WOLVERINE L.
KENT L.
WALLED LAKE
WIXOM
WALLED L.
BIRMINGHAM
CLAWSON
FRANKLIN
B.F.
BEVERLY HILLS
W.C.F.
ROYAL OAK
MADISON HEIGHTS
BERKLEY
LYON
NOVI
NOVI
FARMINGTON
QUAKERTOWN
FARMINGTON
SOUTHFIELD
LATHRUP VILLAGE
ROYAL OAK
H. WDS.
OAK PARK
P.R.
FERNDALE
HAZ. PK.
S. LYON
NORTHVILLE
B.F. = BINGHAM FARMS
H. WDS. = HUNTINGTON WOODS
HAZ. PK. = HAZEL PARK
P.R. = PLEASANT RIDGE
W.C.F. = WOOD CREEK FARMS
● — OPEN DUMP
▲ — SANITARY LAND FILL
▼ — CONSTRUCTION MATERIAL FILL
☒ — PARTIALLY CLOSED DUMP
P — PIGGERY
N
W
E
S
0 1 2 3 4 5
SCALE IN MILES

EXISTING DISPOSAL SITES

FIGURE 6

practiced. Almost without exception, rural and suburban homes display a trash burner or burning barrel in the rear yard. Many commercial establishments in rural areas also burn refuse on the site. Approximately one-third of the industrial concerns indicated on their questionnaires that they also burn refuse in order to reduce the volume that must be removed from their premises.

Burial of refuse is common in agricultural areas. Farmers have ample room to dispose of vegetable trimmings and other miscellaneous garbage items on their own property. Frequently, large lots on which single dwellings are constructed also afford similar refuse disposal opportunities.

In some instances, residents of Oakland County dispose of their refuse in family dumps near their homes. These privately owned open disposal sites usually consist of a large heap of tin cans and bottles thrown by the owner into a marshy area of a ravine. Such open disposal operations are not common in all parts of the County, but can be seen occasionally. This form of refuse disposal breeds rats and flies, and creates health hazards due to these vectors. Further, it is attractive to children, dogs, and other animals, which scatter the refuse or play in it, increasing the possibility of injury to themselves or to passers-by.

THE PROJECTION

The following is a summary of the County refuse disposal program as we envision it. The program entails much coordination of County agencies, and a considerable amount of money, but it is the goal toward which the County should strive. The various aspects of the program are briefly mentioned in the following paragraphs. These aspects will be discussed in more complete detail in ensuing sections of this Report.

General

All over the country public awareness of refuse disposal problems is increasing. Many newspapers and popular magazines have recently devoted space to the subject of solid waste disposal and associated problems. Increased public awareness of the problem will place pressure on responsible officials to rectify present conditions.

The most frequent point of contact between local government officials and the resident is through refuse collection. There is considerable interest on the part of the individual home owner in maintaining good refuse practice or improving it. The greatest demands for improvement of the refuse program of Oakland County will probably concern collection. Improvements in collection will be reflected in increased quantities of refuse that must be cared for by disposal.

The method and location for disposal of solid waste will also be subject to demands for improvement. Not only will the State and local Health Department require the conversion of open dumps to sanitary landfills, but the local residents will be less tolerant of illicit disposal areas and abandoned bulk items. Land for public disposal of solid waste will become scarce as urban development encroaches on rural areas of the County. This urbanization of sparsely developed land will increase the quantities of refuse which are produced in the County and thus aggravate the problem rather than aid its solution. It is imperative that the officials of Oakland County look toward the future in deciding their course. The haphazard crisis-to-crisis type of operation which is typical of the past must yield to an efficient and planned system of solid waste disposal.

Solid waste planning must not be confined to the residential problem. Business and industry are a part of the community too, and their problems are no less acute than those of the domestic segment. The past practice of many communities to exclude certain commercial and industrial refuse must stop and service must extend to all members of the community. However, hazardous and other special wastes can logically be excluded from disposal sites and higher rates charged for hard to handle materials.

If legislative trends continue, open burning will become unlawful. Quantities of refuse will become greater from all segments of the community. Collection of all refuse including that now burned at the point of origin and the collection of leaves can produce a load 9 times that now experienced by some communities, with the average nearer twice current collections. Anticipated increases in quantity must be included in planning for future disposal facilities.

Collection Practice

Refuse collection practice in Oakland County is being upgraded. Replies from the questionnaire sent to local governments within the County indicate municipalities are turning from the use of private haulers to contract collection or municipal collection systems. Private hauling as a collection method is still in common use in the County, but as municipalities are formed and population densities increase, the need for control of collection systems is becoming apparent to public officials. Private hauling will, undoubtedly, continue as a method of refuse collection in more rural neighborhoods and for commercial or industrial installations. Contract or municipal collection will probably be used by the majority of communities in Oakland County in future years.

Improved refuse service will probably include the complete collection of rubbish and garbage in all areas of the County. If contract collection is provided by a city or a township, little problem will exist because collection service will be available to all residents. Commercial and industrial pickup should also be combined collection. Thus, all solid waste including both combustible and non-combustible refuse and garbage will be picked up in a single collection operation since there will be no need to separate for disposal.

Residential collections should be made at least once per week. Public demand may seek more frequent collections, but once-weekly collection in the County area is normally satisfactory. Residential collection should not be more frequent than twice per week. More frequent collection is usually necessary for commercial and industrial customers because of waste characteristics or large volumes.

The County Program

It is assumed the County program will begin where collection service terminates. County service will include transportation of refuse from collection areas to a disposal site, the disposal of refuse generated within the County boundaries, and the maintenance and administration of the solid waste program.

Rural Areas

Open disposal will become less acceptable in rural areas. Dump sites will be closed as the regulations under Public Act 87 are more stringently enforced. Remote landfills serving several townships will not be satisfactory alone because of the distance individuals must haul their waste. County operated collection points are expected to be located at several sites in rural townships so that convenient service is available to all residents. This will provide an interim solution until county or township controlled collection routes can be established in rural areas.

Secondary Transportation

Transportation of refuse in large quantities from convenient points scattered throughout the County will be necessary. The expense of operating collection vehicles is too great to permit them to make extended trips to disposal sites. The limits within which these trucks are able to operate efficiently will become more confined as costs increase. County operated transportation systems will reduce the cost of refuse service by providing economical bulk delivery service for collection vehicle loads.

Disposal

Disposal of refuse will include reduction of bulk. Incineration will provide this reduction for most County wastes. Incineration will take place at a few large plants rather than at many small plants. These plants will be located in areas convenient to road and rail facilities and in undeveloped areas or in currently designated industrial areas.

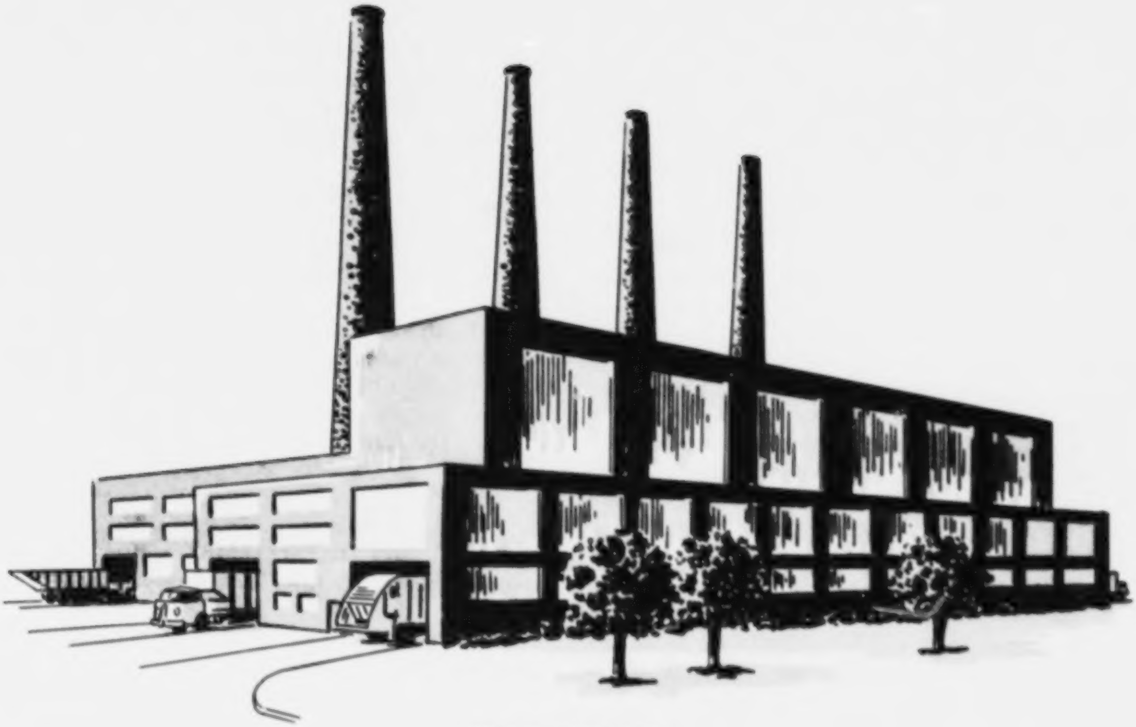
The by-products of incineration, residue and gases, will be treated and disposed of in a safe manner. Residue will be hauled to remote areas of the County for compaction and burial. Gases will be passed through high efficiency cleaning devices to reduce air pollution loadings.

The County will take a more active interest in maintaining a desirable environment for its citizens. More intense efforts at removing and disposing of litter from highways and closing promiscuous dumping areas will be made. Abandoned automobile hulks will be collected by the County and delivered to private disposal facilities for salvage value. Thus, the solid waste disposal program will be a complete one.

Secondary Benefits

The solid waste disposal program will create several secondary benefits for the County. Several roads now in Class B condition must be brought to Class A standards to permit year around use by transportation vehicles. Utility extension to sites will be of benefit to property owners along their routes. Property values will probably increase as a result of removing litter and abandoned vehicles from the landscape. A good solid waste program with adequate facilities for disposal will be attractive to industry. Residue disposal areas can turn undesirable or unusable land into a useful asset after filling is complete.

The County program will require a cooperative effort by the communities of the County. Many townships and villages are too small to finance an effective solid waste program under Public Act 87 for themselves. Cooperation will extend beyond the County boundary as Oakland County establishes a relationship with Wayne County for the disposal of incinerator residues.



INCINERATION

It is generally acknowledged that disposal of refuse represents approximately 20-30% of the total cost of the complete solid waste program. The remaining portion of the cost is consumed by the collection service. The cost of a disposal program is significant even for a mediocre operation. The added cost for an outstanding solid waste disposal program is minor when compared to the total cost of collection and disposal.

The term "Incineration" describes the disposal process whereby refuse is reduced in volume by burning before final disposal. The central incinerator burns waste from many sources and contrasts with on-site incinerators which burn material at the point of origin, such as at an industrial plant, a commercial establishment, or an apartment house. On-site incinerators are not considered in this study; the word "incinerator" will mean publicly owned central incinerators throughout this Report.

Incineration reduces combustible material to a more inert residue. Modern incinerators accomplish this by combining the process of drying wet refuse and burning it in a single chamber within a furnace. The refuse moving slowly through the furnace is consumed, the residue being disposed of by land, whereas gaseous by-products of combustion are discharged to the atmosphere. Incineration reduces the volume of material to be handled in a nuisance-free manner, but it is not a complete method of disposal.

Advantages of Incineration

Incineration requires much less land than does the landfill method of disposal. The incinerator itself can be situated on a relatively small parcel of land. Some of the incinerators in Detroit occupy parcels of less than five acres. Residue disposal requires less land than required for landfilling raw refuse – a significant contribution to conserving land resources.

A more central location is possible for an incineration plant. The incinerator can be located close to the service area in an industrially zoned, or in some instances a commercially zoned area. A well designed building with attractively landscaped grounds surrounding it will make the operation acceptable in many neighborhoods. Locating a plant near the center of the refuse shed reduces the hauling cost.

An incinerator produces a residue that contains small quantities of organic material and is less nuisance than raw refuse. It is often mis-stated that residue from an incinerator is sterile. Recent examinations of incinerator residue indicates that the ash abounds in biological life, but that most of the pathogenic organisms are destroyed by incineration. Residue produced by an incinerator must be covered like raw refuse because of the minute quantities of organic matter.

An incinerator plant can burn many kinds of refuse. It will burn most combustibles to an ash and can even reduce the bulk of some non-combustible components of a mixed refuse. It cannot, however, handle large objects, those which cause excessive smoke, or explosives.

The operation of an incinerator is generally not affected by climate or unusual weather conditions.

Some flexibility exists in the incinerator for handling varying amounts of refuse. A plant can operate 8, 12, 16, or 24 hours per day, for example. The operation can also be carried out on a 5, 6, or 7 day burning week. Grate speed in the furnace may be adjusted within a limited range to regulate the time material remains in the combustion chamber. By modifying the hours of operation, the number of days of operation, and the speed with which the refuse passes through the furnaces, the incinerator plant is capable of handling a wide range of refuse volumes as created by its contributing population.

Disadvantages of Incineration

The incinerator has several disadvantages which must be weighed against the advantages outlined above. The incinerator is expensive in capital cost as well as operating cost. Depending upon the type and size of unit constructed, the initial cost will vary from $4,000 to almost $10,000 per ton of rated daily capacity, whereas the operating cost can range from $5.00 to $9.00 per ton of rated daily capacity, including residue disposal and amortization.

Skilled employees are required to operate, repair and maintain an incinerator. These men are more in number and generally higher paid than employees at a sanitary landfill.

Maintenance and repair costs are also higher because of the type of equipment involved in the furnaces. Equipment is often damaged by wire, fusable metals, abrasives, or explosive objects entering the furnace with the refuse.

The combined high capital investment and the costly maintenance and repair for incinerators create a per ton cost for refuse disposal considerably higher than for sanitary landfill.

It is often difficult to obtain the best site for an incinerator because refuse disposal operations are not acceptable to many people. Because of heavy truck traffic, the possibility of noise, or other real or imagined nuisances, incinerator locations are frequently confined to industrial areas. Even this precaution will not prevent nuisance complaints from nearby residents.

Incineration does not complete the job of disposal of the community's waste. Residue and flyash must be transported to a landfill site for burial.

Incineration Location

It is necessary to make a decision where an incinerator plant will be located. The site selection involves engineering problems and public acceptance of the chosen location. Often the engineering problems are the easiest to solve.

Locations central to the load from the service area usually result in the lowest collection costs. Topography and soil conditions have a distinct influence on construction costs. Hillside sites can reduce construction costs by permitting designs where the refuse flow roughly parallels the natural ground surface. This results in less excavation and simpler structural design than a multi-storied plant on flat ground. Sub-surface soils and ground water will have a profound effect on foundation design and underground structures.

In urban and suburban areas such as those prevailing in much of Oakland County, the site selection problem is usually most difficult. If the site is to be located near residential property nearby residents will object out of apprehension regarding nuisances from smoke, dust, odor, noise, and intense truck traffic. These citizens are also concerned about possible reduction in property values. Some of these fears may be justified by past experience with incinerators that have been poorly operated, designed or managed or may have been overloaded. Modern incinerator design minimizes many of the sources of past complaints. However, even the most careful selection of a location in intensely industrialized areas may not eliminate objections which may come from residents several thousands of yards from the site.

We propose to locate incinerators in industrially zoned land to reduce objections. The sites will be chosen to be adjacent to or reasonably close to railroads and good primary roads. Site access roads are proposed for improvement if they do not now meet Class A standards of the County Road Commission. We will select sites where public utilities are existent or planned for the near future or where wells and private treatment plants will be the least objectionable.

Incinerator Characteristics

The term "incinerator" generally provokes a picture of a box-like, red brick structure with a tall stack emitting a large plume of black smoke. The ground around the incinerator is visualized as littered with blowing papers and the driveways filled with refuse trucks making their way in and out of the site. This picture need not be correct.

A modern incinerator can be as architecturally aesthetic as many industrial or commercial buildings. The tall stack is no longer a necessity, although in some instances it is very desirable. Better furnace design and operating techniques combined with modern air pollution control equipment eliminates the plume of black smoke, whereas blowing paper is controlled by enclosed dumping areas. The type of operation which once was an eyesore has been largely eliminated through better operational and maintenance practices. A modern, well-operated incinerator is an asset rather than a liability to the community.

Incinerators reduce the materials handling problem significantly. The residue of a modern incinerator represents approximately 1/3 the weight of material introduced to the furnace. At the same time that the weight is being lessened, the volume of material is reduced to approximately 1/5 of the delivered volume. Much of this material is converted to gaseous by-products of combustion such as water vapor, carbon dioxide, and several minor gases. The remaining residue is a mixture of metal, glass, ashes, dirt, and other non-combustibles with a small amount of unburned carbon.

A modern incinerator plant can be operated to minimize nuisance problems. With proper care of operation a well designed incinerator can function without excessive dirt, dust, noise, or odor. A successful operation will require constant attention and control to prevent overloading which often is the cause of these nuisance problems.

We discuss the various types of incinerator plants in more detail in the following paragraphs.

Types of Incinerator Furnaces

Incinerators recently designed for municipal use are fed refuse continuously throughout the burning period. The ability to receive fuel (refuse) in this manner eliminates many of the problems associated with municipal incinerators of the old batch feed design. Among the advantages of continuously fed incinerators are large furnace capacity, excellent control of combustion and near uniform furnace temperatures which reduce thermal damage to components.

We have studied two classes of continuous feed furnaces which we believe applicable to Oakland County. These are refractory lined furnaces and water wall furnaces. The following paragraphs will discuss these different classes of incinerators, together with common modifications, in more detail.

Refractory Furnaces

Refractory lined furnaces are commonly used for refuse incineration in American practice. The refractory furnace is a proven system and is the most economical type of unit in sizes under 250 tons per day. Refractory furnaces are limited to a maximum size of approximately 300 tons per day. Above this limit, increased maintenance and operating costs begin to offset the cost of adding another smaller unit.

Refractory replacement is a costly item for this type of furnace. Refractory is damaged by overheating, slagging, chemical reactions, erosion of the furnace lining by the materials in contact with the brick and by heating and cooling of the furnace. Wide temperature variations in the furnace produce refractory damage through expansion and contraction and through moisture. When the unit is allowed to heat and cool, stresses are created in the brick and furnace frame. These stresses cause movement of the furnace lining, which in turn can chip or break the bricks. Condensation of moisture also occurs when the furnace is cooled. Moisture is absorbed by the refractory lining and when the furnace is brought back to operating temperature, turns to steam. The rapid expansion of gas in forming steam creates a pressure within the brickwork which spalls off the face of the lining. Replacing refractory usually means a furnace is out of service for two weeks or more, and that some refuse must be sent to the landfill for disposal.

Furnace relining is a costly operation. Reports from plants across the country indicate that relining is required typically every two or three years. The cost of relining will range from $20-$30 per square foot or $100,000 or more for a complete relining of a 300 ton per day furnace. In addition to the major relining projects, minor repairs to brickwork are often required whenever a furnace is taken out of service. The cost of these repairs varies widely, depending upon the extent of damage, but the square foot cost cited above is appropriate. Repair and replacing furnace refractory are a substantial portion of the annual cost of operating this class of incinerator.

The brick lined furnace relies on air for cooling. This air must be supplied in large quantities to prevent overheating of the refractory lining and excessive slagging of the walls. This excess air joins the combustion gases and must be passed through the air pollution control equipment. The larger volumes of gas being treated for particulate matter removal increase the cost of air pollution control devices.

The refractory lined furnace does not require licensed personnel for operation. However, every effort should be made by the operating authority to employ men conscientious in their work and trained in the problems involved in refractory furnace operation. Such men can soon become qualified as efficient incinerator operators and become skilled in maintaining the plant in its optimum condition. The savings in labor and operating expenses inherent with the refractory furnace must be weighed against the higher maintenance cost associated with this type of unit.

Operating personnel is an important consideration of incinerator cost. There is no way of estimating manpower requirements on a per ton basis because this will vary with the design of the plant. Interviews with operators and superintendents of several plants indicate most are understaffed. Indeed a few seem to pride themselves on how few men are required to operate their installation, but the result is usually a dirty, poorly maintained plant and grounds.

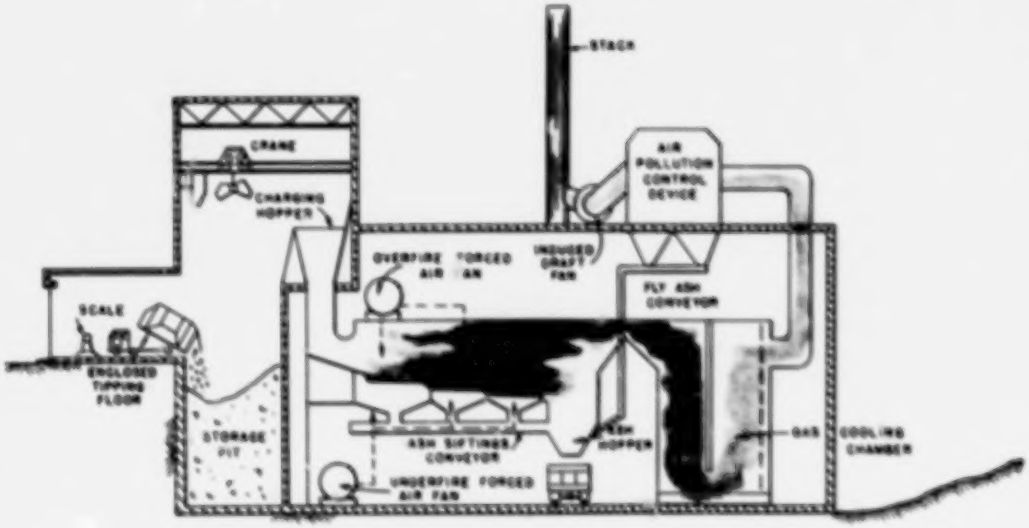
Typical labor requirements for a refractory incinerator are as follows:

Superintendent	1
Scale Attendant	1 per shift when deliveries are made
Tipping Floor Attendant	1 per shift when deliveries are made
Crane Operator	1 per shift per crane used
Charging Floor Attendant	1 per shift
Fireman	1 per shift for every 3 or less furnaces
Fireman's Helper	1 per shift for every 2 furnaces
Electrician	1
Mechanic	1
Laborer	2 - day shift; 1 each other shift
Janitor	2 - day shift; 1 each other shift

Relief personnel will be needed when operation is on a seven day per week basis or when operation must be continued around the clock.

The refractory lined furnace is economical in terms of initial cost for all unit sizes and in all plants studied with from one to five units per plant. The average range of capital cost for refractory incinerators is $4,000 to $7,000 per ton of rated capacity, depending on individual unit sizes and number of units per plant. These cost figures are exclusive of residue disposal and land. A more detailed explanation of the basis of comparison and the results of the furnace study will be given later in this discussion.

A typical cross-section of a refractory lined furnace installation is illustrated in Figure No. 7.



TYPICAL REFRACTORY LINED INCINERATOR

FIGURE 7

Water Wall Furnaces

The water wall furnace uses water-filled tubes to form the furnace wall. This type of furnace for municipal refuse incineration has found wide application in European and South American installations. There is one water wall incinerator in operation at the Norfolk Naval Base in Virginia. This unit has been in operation for over a year. Other water wall furnace construction is currently planned for Chicago and New York City.

Water wall furnaces can be constructed for a large range of capacities. The minimum practical size of water wall furnace is 200 tons per day, and the maximum is approximately 600 tons per day. In multi-unit incineration plants using large furnaces the ability to deliver refuse to the plant will become an important consideration.

The walls of the water-cooled furnace consist of a series of tubes connected by fins or welded directly together. Heat is transferred from the burning refuse through the wall to the water in the tubes. The water filled tubes form the cool wall in contact with the flame and hot gases, preventing the accumulation of slag.

Water cooling reduces the use of excess air. Excess air in water wall furnaces can be held to approximately 50% to 60%, although provision for supplying 100% excess air is advisable. The volume of air passing through the furnace has a direct effect upon the size of air pollution control devices. A secondary advantage of restricting excess air quantities is the introduction of less moisture in the form of humidity into the gas stream.

Moisture in the furnace can be a problem with water wall furnaces. The moisture may combine with gases formed by the combustion of plastics and certain other materials found in refuse. If the moisture and gas combine, they could form an acid capable of damaging the walls and boiler tubes. Inspection of the Norfolk incinerator, the only water wall refuse incinerator in the United States, after nine months of operation revealed little corrosion of the tubes. The Norfolk plant should provide extreme conditions since the furnaces are shut down each week and no supplementary heat is supplied during the shutdown period. The formation of corrosive acids can be minimized by using supplemental heat during the period the furnace is out of service.

Tube replacement in water wall furnaces is an infrequent maintenance problem according to European experience. The experience of boiler operators for industry and power generation indicates that the need for tube replacement may occur at periods in excess of 5 to 7 years. Tube failures in industrial furnaces are frequently caused by erosion of the tube by entrained flyash. A thorough rebuilding job is normally done at the time of the first repair as a preventative maintenance operation. European incinerator or American boiler practice is not easily related to American incinerators because of differences in fuels. There has not been enough experience with water wall refuse incinerators in this country to provide an accurate forecast of wall maintenance costs.

Water wall furnaces require specialized and careful treatment of the water used in the boiler. Treatment removes foreign material which is potentially damaging to the boiler parts. Among the impurities to be removed are scale and sludge forming materials, soluble salts, oil, dissolved or releasable gases, and other materials by the same methods used to treat boiler water in power plants.

The water wall furnace requires skilled personnel for efficient operation. Licensed power plant operators and firemen should be available on the floor of any steam generating plant. A water wall furnace is a boiler plant, and the installation should employ the same qualified personnel. Such personnel demand higher salaries than the men normally hired for refractory wall furnaces.

Typical labor requirements for a water wall furnace are as follows:

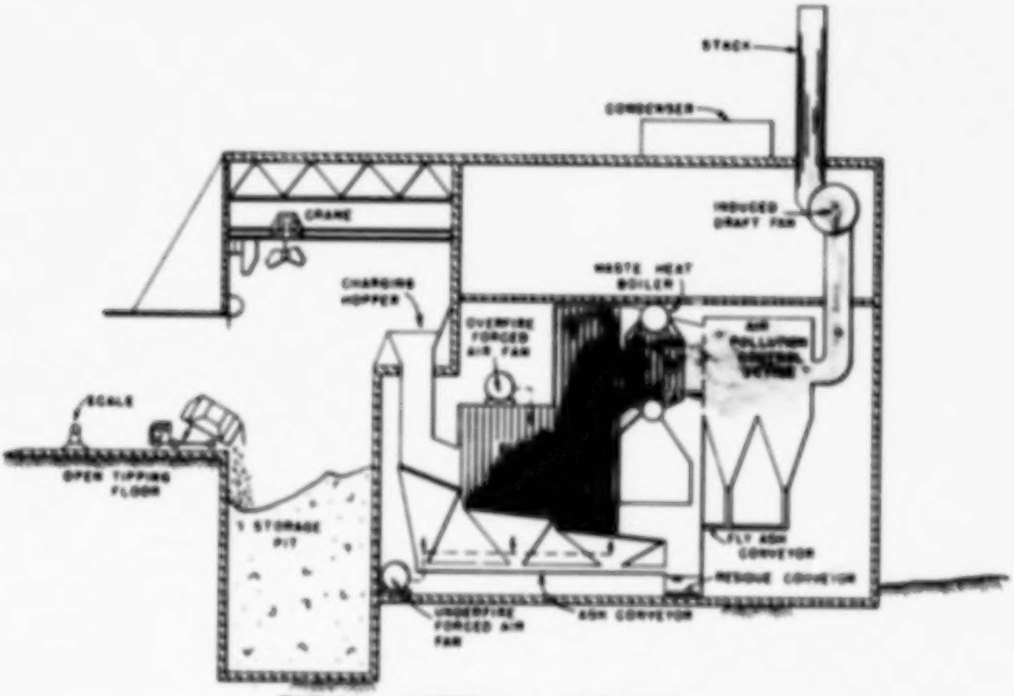
Superintendent	1
Scale Attendant	1 per shift when deliveries are made
Tipping Floor Attendant	1 per shift when deliveries are made
Crane Operator	1 per shift per crane used
Charging Floor Attendant	1 per shift
Power Plant Operator	1 per shift
Asst. Power Plant Operator	1 per shift
Fireman	1 per shift for every 3 or less furnaces
Fireman's Helper	1 per shift for every 2 furnaces
Electrician	1
Mechanic	1
Millwright	1
Laborer	2 per day shift; 1 each additional shift
Janitor	2 per day shift; 1 each additional shift

Relief personnel will be required for 7 day operation or when operation must be continuous around the clock.

Recent studies have promoted water wall furnaces on the basis of recovery or sale of steam generated. The effort to conserve the valuable by-product is a laudable one; however, unless a ready market is available, it is an impractical consideration. We believe that the possible sale of steam as a by-product of water-cooled furnaces is a possibility and do not dismiss it summarily. However, because ready markets are not available at most sites selected in the recommended plans, we do not consider the sale of steam as part of our economic study.

The capital cost of constructing water wall incinerators with waste heat boilers is in the range of $5,000 to $9,000 per ton of rated daily capacity based on information furnished us by equipment suppliers and contractors. However, recent bids taken in Chicago for water wall furnaces approached $11,000 per ton of rated daily capacity. There were some contract conditions for this bidding which could have caused high contract prices. We believe that the middle to higher end of the range is most appropriate for consideration of costs for Oakland County. These costs do not include the cost of land or of residue disposal and transportation.

A drawing of the essential features of a water wall furnace with waste heat boiler appears in Figure No. 8.


STACK
CONDENSER
CRANE
INDUCED DRAFT FAN
WASTE HEAT BOILER
CHARGING HOPPER
OVERFIRE FORCED AIR FAN
AIR POLLUTION CONTROL SYSTEM
SCALE
OPEN TIPPING FLOOR
STORAGE PIT
FLY ASH CONVEYOR
RESIDUE CONVEYOR
UNDERFIRE FORCED AIR FAN
ASH CONVEYOR

TYPICAL WATERWALL FURNACE
WITH WASTE HEAT BOILER

FIGURE 8

Modifications of Furnaces

Many attempts have been made to improve performance of incinerator furnaces. These attempts have resulted in several modifications and we believe the two major ones, waste heat boilers and rotary kilns, deserve discussion at this point.

Waste Heat Boilers

Incinerator gases must be cooled from 1800-2000 F to 400-600 F before discharge to the atmosphere. Cooling the gas is done to reduce gas volumes, to reduce damage to furnace components and to improve fan efficiency. Gas cooling is an important part of incinerator operation.

General practice cools gas by dilution with excess air and/or water spray. Both methods add to the volume of gas to be handled by the following furnace components and to the moisture content of that gas. Both methods remain popular because they require little additional capital expenditure and sprays provide a limited amount of air pollution control.

However, more stringent air pollution regulations will increase the need to minimize air volumes and moisture passing control devices.

Waste heat boilers can be installed in the furnace to cool combustion gases without introducing great amounts of excess air or moisture. The boiler consists of several tubes which the gas must pass as it leaves the furnace. The heat carried by the gas is transferred to water contained in the boiler tubes. Waste heat boiler installations are illustrated in Figures No. 8 and 9.

The heat passed to the boiler water must be dissipated or explosions will result. Heat is converted to steam and may be used for heating, auxiliary power, to drive steam driven equipment or for other purposes. In-plant steam use will consume approximately 10%-15% of the total steam produced.

Excess steam should be condensed and recirculated to conserve boiler feed water. Condensation takes place in cooling towers. Forced air cooling towers mounted on the roof of the incinerator will be satisfactory for condensing surplus steam.

A substantial added expense is incurred by providing a boiler bank and condensing equipment in a refractory furnace instead of conventional cooling. The cost of adding waste heat boiler equipment at a refractory furnace is $1500-2500/ton of capacity. The cost for comparable equipment in a water wall furnace is $2000-3500/ton. The cost is lower for the refractory furnace because large quantities of dilution air are used for gas cooling, a situation not encountered in the water wall furnace. With air dilution, the size of boiler bank required to lower combustion gas temperatures to a suitable range can be reduced.

The annual cost of maintaining and operating boiler banks in refractory and water wall furnaces is essentially the same. Compared to the annual cost of maintaining refractories, grates and other components, this cost is negligible.

The annual cost of operating furnaces with waste heat boilers varies with the class of furnace. In a refractory furnace the same high salaried, specialized personnel would be required as in any steam generating incinerator plant. The additional cost of boiler tube maintenance and the cost of processing feed water must be added to the already high cost of operation and maintenance of the refractory furnace. Most of these additional annual costs do not apply in the case of water wall furnaces. Here the only additional real cost would be the added capacity of boiler water treatment equipment and of the additional cost of tube repair in the boiler bank.

Rotary Kiln

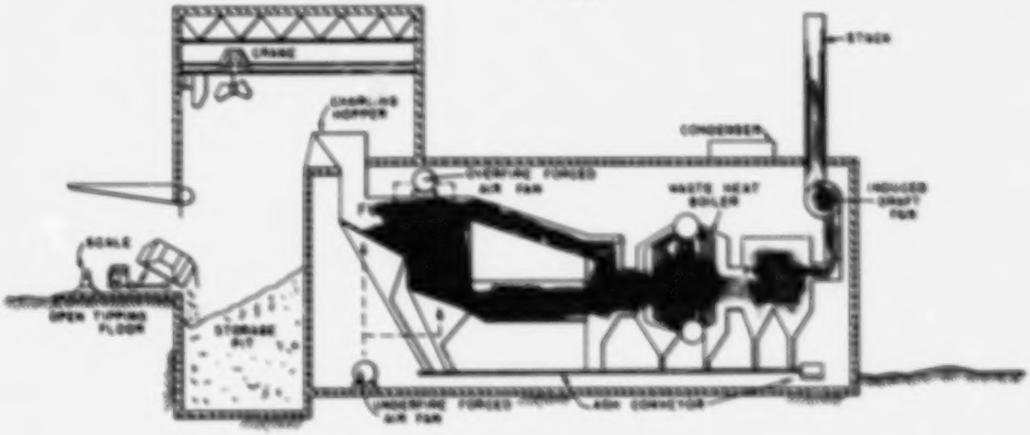
The rotary kiln modification of the refractory furnace provides a chamber in which hot gases pass over the residue from the grates. The kiln rotates slowly on its long axis, tumbling the material being burned. The residue leaving the kiln contains less putrescible material than residue from standard grates.

Rotary kiln furnaces are of European design and are licensed to a company in the U.S. for manufacture and sale. These units are produced currently in the 250 ton per day size only, although the company is considering production of larger units. Past construction couples rotary kilns with refractory furnaces only, but it seems technically possible to couple a refractory kiln with a water wall furnace. However, such a hybrid unit would probably have most of the disadvantages of both types of furnace construction and few of the advantages.

Operating and installation costs for rotary kiln modifications to refractory furnaces are readily available for 250 ton per day units. The licensee has provided us with their estimates of cost for 300 ton per day furnaces. Construction costs range from $5000 to $9000 per ton of rated daily capacity adjusted to present day prices. Operating and maintenance costs are approximately 20% greater than for refractory furnaces of equal capacity without the kiln modification.

A drawing of a typical rotary kiln incinerator followed by a waste heat boiler appears in Figure 9.

and building construction cost. Much of the data from which annual costs are derived were obtained or verified from existing municipal incinerators or similar industrial operations. The cost of residue transportation and final disposal, and the cost of land were excluded from this study.



TYPICAL ROTARY KILN INCINERATOR
WITH WASTE HEAT BOILER
FIGURE 9

Comparison of Incinerator Systems

The preceding discussion compares the advantages of the major classes of incinerators and certain of their modifications. Such comparisons are beneficial, but must be supplemented by a study of capital and annual costs to provide an effective comparison of the units under consideration.

The incinerator systems proposed for study in Oakland County are refractory lined furnaces, refractory lined furnace with waste heat boiler, refractory lined furnace with rotary kiln, and water wall furnace with waste heat boiler. The comparative cost for these incinerator systems is based on information supplied by manufacturers of the various types of equipment included in our estimates for structures and accessories used in a complete plant. In most cases, more than one manufacturer of a system component was consulted in order to clarify what was involved and the cost. This information was assembled along with estimates of labor cost, utility cost, maintenance and operating cost, installation cost,

To provide as varied a representation of unit sizes as possible, the comparison was made of 100, 200, 300, and 400 ton per day units to be operating in plants containing from 1 to 5 units.

Initial comparison of units based on capital costs reveal the water wall furnace with waste heat boiler is the most expensive type of all units. This higher cost for water wall furnaces remains constant for all unit sizes and combinations of units from 1 to 5. The refractory furnace with rotary kiln is a close second to the water wall furnace in terms of capital cost.

Refractory furnaces with waste heat boilers and refractory furnaces alone are the least expensive units compared for capital cost. This is true, despite the fact that larger air pollution control equipment was included for both the refractory furnace and the refractory furnace with rotary kiln, in order to achieve equal stack emissions in terms of particulate matter.

A more significant basis of comparison is that of annual cost. When capital costs are

TYPICAL COMPARATIVE COST FIGURES FOR FURNACE SYSTEMS

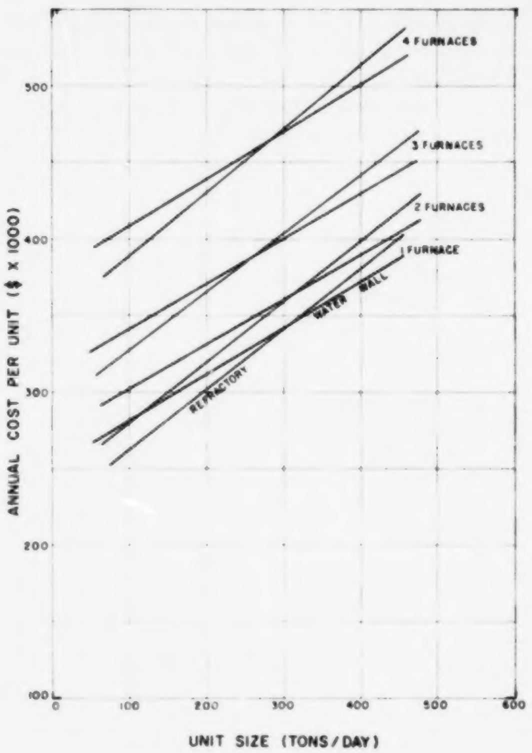
3 UNITS @ 300 TONS/DAY

	Water Furnace with Waste Heat Boiler	Refractory Lined Furnace	Refractory Lined Furnace with Waste Heat Boiler	Refractory Furnace with Rotary Kiln
Incinerator Structure	$2,240,000	$2,290,000	$2,240,000	$2,290,000
Utility Construction	259,000	265,000	256,000	265,000
Furnace Components	2,933,000	903,000	2,375,000	3,253,000
Air Pollution Control Equipment	690,000	1,500,000	900,000	1,500,000
Estimated Project Cost	$6,122,000	$4,958,000	$5,771,000	$7,308,000
Amortization of Capital Cost Based on 4½% Annual Interest, 20 Yr. Bonds	$ 472,000	$ 380,000	$ 447,000	$ 563,000
Plant Labor	520,000	495,000	520,000	496,300
Utilities	15,000	35,000	15,000	36,500
Building Supplies, Operation & Maintenance	193,000	312,000	280,000	350,400
Estimated Annual Cost	$1,200,000	$1,220,000	$1,262,000	$1,446,200

reduced to annual bond retirement costs, and operation, maintenance, labor, and other annual costs are included in the comparison, the advantage no longer remains with the refractory furnace in all cases. The refractory furnace in unit sizes under 250 to 300 tons per day is less expensive on the annual cost comparison. However, in unit sizes above this range the water wall furnace with waste heat boiler becomes less expensive. This situation occurs primarily because of the increasing maintenance and operating costs of refractory furnaces in sizes exceeding 250 tons per day. Installations containing from 1 to 5 furnace units consistently show this reversal of cost between refractory and water wall furnaces. In all cases, the annual cost of refractory furnaces with waste heat boiler and refractory furnaces with rotary kiln is more than for either refractory furnaces or water wall furnaces with waste heat boilers. The Table on the preceding page presentsa sample comparison for three 300 ton per day incinerator units as an illustration of the economic comparison performed for all unit capacities and for installations of from 1 to 5 units.

The figures presented in the Table exclude the cost of residue disposal, land, and landscaping. The cost of these items depends on the individual site selected for residue disposal or for the incinerator plant. The item entitled "Incinerator Structure" includes building, foundation, and stack. The item for "Utility Construction" consists of the cost of extending public utilities to the plant and for the cost of treating waste water discharged from the incinerator. Grates, refractory or water walls and arches, scales, cranes, hoppers, fans, duct work, and where applicable boiler banks and auxiliaries are included under the heading "Furnace Components". "Air Pollution Control Equipment" consists of electrostatic precipitators and associated equipment. All cost figures are projected to the year 1970.

The result of the complete comparison between water wall furnace with waste heat boiler and the refractory furnace is shown graphically in Figure No. 10.



COMPARATIVE COST OF MULTIPLE UNIT REFRACTORY AND WATER WALL INCINERATORS EXCLUSIVE OF LAND, LANDSCAPING AND RESIDUE DISPOSAL

FIGURE 10

Evaluation of Incinerators

Little advantage can be ascribed to the use of refractory furnaces with waste heat boilers. On the basis of cost they must be excluded from further consideration for use in Oakland County.

Rotary kiln incinerators are more costly than the refractory furnace with waste heat boiler in terms of annual cost. Incinerator residue should be buried, so the better quality residue from a rotary kiln is of little advantage. Furnace sizes exceeding 250 to 300 tons per day for rotary kiln units are not currently available. For these reasons we eliminate from consideration rotary kiln furnaces.

Refractory furnaces show a good annual cost ratio in sizes under 275 tons per day. The cost disadvantage is very slight between 275 and 300 tons per day, and refractory furnaces should be considered for use in all sizes up to the currently accepted limit for capacity, which is 300 tons per day.

Manufacturers of water wall furnaces recommend furnace sizes for their equipment ranging from 200 to 600 tons per day per furnace. Our economic evaluation indicates that this equipment is more advantageous in terms of annual cost in sizes above 300 tons per day. We believe a practical limit to water wall equipment will be 500 ton per day units. The use of water wall equipment in sizes under 300 tons per day can be economical only if the waste heat can be economically used.

Based on the foregoing evaluation, we will use refractory furnaces in sizes up to 300 tons per day and water wall units above that size in our comparison of possible alternative plans.

Components of Incinerators

An incinerator plant is composed of many parts. The furnace and furnace construction are not the only components required to make the incinerator a functioning unit. Such items as scales, tipping floor, cranes, stacks, air pollution control devices, and the building which surrounds the equipment combine to produce a functioning plant. The following paragraphs will discuss briefly various aspects of each of the many other components of the incinerator.

Scale

The first component of the incinerator which any entering refuse vehicle will encounter is the scale. The weighing apparatus should be large enough to accommodate the largest vehicles which will roll over it. A 60 foot platform will permit the 55 foot long transfer vehicles to be weighed. The scale capacity should be approximately 60 tons. The weighing platform of the scale should be located so that it is easy for the vehicles to gain access to the dumping areas.

The weighing head should be located indoors and may be at a location either close to or remote from the platform of the scale. In either case the platform should be easily seen from the weighing head. The weighing head should indicate the weight of the vehicle and include an automatic tare which isolates the load weight from the vehicle weight. The equipment should be provided for entering a vehicle identification number into the scale and for printing the load weight of that vehicle on a weigh slip. The scale should be easy to use and easy to read. Controls are needed if the operator is remote from the scale platform. In this case, a manually operated traffic signal can inform the driver that the weighing is complete and he is free to travel to the dumping area.

At larger installations, two scales may be required to handle the truck traffic entering the incinerator.

Tipping Floor

The tipping floor is the area in which the refuse vehicles dump their loads to the pit. The tipping floor should be closed for northern climates as a way to reduce problems created by inclement weather. Enclosing the tipping floor also prevents the blowing of papers and confines dust which is created as the vehicles unload. Open tipping floors have recently been advocated, particularly in the southern states, but the open floor is not adequate for northern climates.

The tipping floor should be of ample size to allow refuse vehicles to maneuver easily. If tractor-trailer units are to use the tipping floor, the turning radius of this equipment must be kept in mind during the design. The traffic pattern in the tipping floor area should be such that the pit area is to the left of the driver as he backs into a loading position. Hold-down chains should be available at each unloading position to prevent trucks from tipping into the pit as they discharge their loads. Head room should be sufficient to accommodate the largest vehicles expected.

When transfer vehicles are used, the large trailer units are difficult to maneuver in the confined tipping area. We suggest that incinerators receiving refuse from transfer stations be designed so that the transfer vehicle will discharge to the pit at a point other than where collection route vehicles dump. The ends of the pit or a tunnel behind the pit could be provided with hoppers for unloading side dumping transport vehicles. Such isolated dumping areas for transport vehicles relieve congestion which would otherwise occur on the tipping floor and save considerable time for route truck unloading.

The tipping floor should be attended during all hours in which vehicles unload. The attendant's duties include directing trucks to the proper unloading position and keeping the tipping areas clean. To aid in keeping the tipping area clean, he should be provided with a small sweeper vehicle to pick up papers and dust which accumulate on the floor during the unloading of vehicles.

Refuse Pit

The refuse brought to the incinerator by the trucks is emptied into the pit. This is a large bunker in the floor for storing refuse until it can be burned in the furnace. The pit acts as a reservoir from which accumulated refuse can be drawn.

The pit should be large enough to store between 1 and 2 days' supply of refuse. This will permit operation of the route trucks 5 days of the week, and still allow 6 or 7-day operation of the plant under emergency conditions. The pit dimensions should provide ample unloading space for refuse vehicles, and the width of the pit should not exceed 30 feet unless transport vehicles are unloaded on both sides. Drains and sprays or other dust control devices should be installed in the pit.

The pit should be designed to permit unloading by the cranes in the event the refuse cannot be fed to the furnaces. This can be accomplished by providing a place to position vehicles under the crane from the tipping floor. The crane can then empty the refuse pit into roadable vehicles for transportation to an emergency disposal area. The emergency emptying feature also allows the cranes to unload heavy equipment received at the plant by truck.

Crane

A reliable heavy-duty crane system should be provided to transfer refuse from the pit to the charging hopper of the furnace.

Bridge cranes provide the greatest versatility of movement available for incinerator operation. This versatility is needed to mix the refuse which enters the pit and to move refuse from the pit to the charging hopper. Mixing of refuse is needed to obtain a more uniform charge for the furnace.

More than one crane is needed in most installations. The size, capacity and number of cranes is dependent upon the amount of refuse being handled. In most cases, a spare crane is desirable as standby equipment. Standby cranes or readily available spare parts are required to prevent complete plant failure in the event of a breakdown of one crane component. Without the crane, the incinerator cannot operate.

Charging Hopper, Gate and Chute

Refuse which is taken from the pit by the crane is charged to the furnace through the charging hopper and chute. This arrangement is a funnel-style passage through which refuse enters the furnace. In continuous feed furnaces such as those proposed in Oakland County, refuse in the chute acts as a seal between the furnace and the charging floor. When the furnace is shut down, a hydraulic gate should be available to close the chute and provide the necessary seal until the charge has been burned out. Other less expensive forms of closing the chute are available, but do not appear satisfactory where intermittent operation can be expected.

Grates

There are three general types of grates now being used in the United States. These are the chain, reciprocating and rocking types. They are all modifications of grates used for homogeneous fuels such as coal, wood chips, bagasse or other specialized industrial fuels.

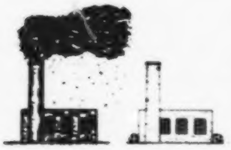
The function of the grates is to provide an area on which the fuel bed rests during burning.

The grate is perforated to permit underfire air to pass through and cool the metal. The reciprocating and rocking grates mechanically agitate the fuel bed to expose unburned material to the flame. The chain grate does not agitate material and hand raking or slashing must be done to achieve a high degree of burnout. We recommend against the chain grate for this reason.

A comparison between the two agitating grate types is not easy. Both have advantages and disadvantages; strengths and weaknesses. The rocking grate provides more agitation, but may introduce more flyash into the effluent gas stream in so doing. The agitation performed by the reciprocating grate is less violent and seems to retard flyash production. We believe these two types of grates are equally appropriate to modern incinerator design and submit that the selection of grate type be left to the discretion of the engineer at the time design plans are drawn. However, we emphasize that an agitating grate should be used.

Air Pollution Control Devices

There are two basic types of gas cleaning systems – wet and dry. The wet system incorporates water to remove particulate matter from the gas stream. The dry system of air pollution control permits no water to contact the gas stream in removing particulate matter. Each system has its merits when applied to refuse incineration under specific conditions or circumstances.



In 1966, Mr. James A. Fife and Mr. Robert H. Boyer, Jr. presented a paper in which they discussed the relative efficiency and cost of various types of air pollution control equipment. The information contained in their paper is of a relative nature and cannot be considered specific to any case. The wet cleaning systems were evaluated separately from the dry cleaning systems, and the dry cleaning systems assumed the sale of all steam generated in the boilers which preceded the air pollution control units. For this reason, the figures presented for cost for dry systems must be evaluated separately from the cost indicated for wet systems. However, a comparative cost of scrubbers and precipitators is presented in the table for wet systems. The various types of equipment which were considered in the study included baffled spray chambers, spray cooling chambers, wet scrubber systems, mechanical cyclone collectors and electro-static precipitators.

A summary of the results of the Fife and Boyer study is contained in the following Table.

WET SYSTEMS

Device	% Efficiency	$ Cost per ton burned
Baffled Spray Chamber	50	0.77
Spray & Cyclone	78	1.12
Wet Scrubber	96	2.10
Spray w/Electro-static Precipitator	95	1.10
DRY SYSTEMS		
Cyclone	78	0.38
Electro-static Precipitator	95	0.39

In 1968, Mr. J. H. Fernandes presented a paper before the National Incinerator Conference which included data on cost of operating air cleaning devices based on the volume of air treated per minute. This comparison accounts for differences in equipment size resulting from the type of cooling (air or water) used and provides a fair comparison between electro-static precipitators, wet scrubbers and cyclones. His figures for maintenance and repair appear in the following table.

Collector	$ Per CFM Annually (Range) Maintenance & Repair
Mechanical Collector	$.005 - $.02
Electro-static Precipitator	.01 - .025
Wet Scrubber	.02 - .05

Michigan Air Pollution Control Code presently permits 0.30 lbs. of particulate emission per thousand pounds of flue gas corrected to 50% excess air. Bear in mind that legislated codes establish the maximum pollution allowed; no minimum is set. We believe that a realistic minimum which can be attained by any incinerator plant is 0.20 pounds per thousand corrected to 50% excess air. This lighter discharge makes available a safety factor to insure compliance with existing codes and allows some leeway for future restriction on emission standards. Pollution control efficiencies in excess of 93% are required to meet the proposed 0.20 pounds standard.

From the foregoing Tables the only devices capable of meeting such a standard are the wet scrubber and the electro-static precipitator.

The wet scrubber is a highly efficient device for removing dust particles from the gas. Gas may be bubbled through a water bath or water injected into the gas stream. The water traps the dust particles and is treated before recirculation. Wet scrubbers are associated with medium to high draft losses in the furnace, thus requiring larger fans.

Electro-static precipitators are a high efficiency dry dust collector. The precipitator consists of a series of plates between which are suspended wires. Dust particles receive an electrical charge from the wire, and are attracted to the oppositely charged plates and thus removed from the gas stream. The material which collects on the plate is removed to a receiving hopper by automatic rappers which vibrate the plates and dislodge the dust. Gas temperatures for electro-static precipitators are critical and must fall between the range of 350° F. and 570° F. Gas velocities through the unit are also critical and cannot exceed 8 feet per second for incinerator use.

A small cyclone collector should precede a precipitator to catch large particles of flyash which could short-out the unit.

Mechanical cyclone collectors are a dry system relying upon centrifugal force to separate suspended particulate matter from the gas. Gas is introduced into the cyclone to produce a spiraling motion which throws the solid particles to the outside wall. The center core of clean gas is removed whereas the dust falls down the walls into a hopper from which it can be removed without interrupting the gas flow.

The efficiency difference between wet scrubbers and electro-static precipitators is not significant. The operating costs between the two units do show a significant difference. The precipitator has been used extensively in Europe and is being tested in this country on a plant scale in New York. If the results of these tests are favorable, precipitators should be used on all installations in Oakland County.

Stack

A tall stack has been the symbol of a municipal incinerator plant This symbol is disappearing rapidly with modern technology. The tall stack was used to provide draft and to get the gaseous discharge high enough to be dispersed by the atmosphere. More sophisticated air cleaning equipment and the use of induced draft fans will permit the use of short stubby stacks which are conducive to a more attractive incinerator architecture.

Both the short and the tall stack have their place. Characteristics of the terrain and surrounding development will to some extent dictate the type of stack which accompanies a particular incinerator plant. Careful selection of the site with consideration for prevailing winds, nearby development and other factors will help make the short stack design feasible.

Residue Handling Equipment

Incineration is a combustion process which leaves a solid by-product called "residue". Residue is a mixture of unburned refuse, ash, tin cans and other non-combustibles that must be removed from the furnace and cooled. Cooling is accomplished by quenching. Quenching eliminates the hazards of fires, smoke and odor.

Two forms of residue collection systems are in common use in American incinerator practice. These are: an ash hopper beneath the grates, and the conveyor type of collection device.

Ash hoppers receive residue from the end of the grate for intermittent discharge. In the interest of economy and operation, the hopper should be large enough to store residue for several hours. Quenching is accomplished with water from spray nozzles beneath the grates. Each hopper is normally equipped with discharge gates.

However, these gates frequently leak and create a messy environment in the ash tunnel. The ash tunnel provides a place where trucks can be driven directly beneath the hoppers to receive the quenched residue. Ash tunnels should be paved, well-drained, and well-ventilated. Drainage carries away the water leaking from the ash hoppers and from washing down any spillage. Ventilation is important to remove dust and steam rapidly from the tunnel.

More common than ash hoppers for continuous feed type incinerators is the immersion type residue collection system.

In this system residue is discharged from the grate to a water trough or tank long enough to receive residue from all furnaces. An endless chain conveyor system drags the settled ash from the bottom of the trough and deposits it in a storage hopper or directly into the transport truck. Most of the quenching water contained in the residue is drained as the conveyor moves the material up an incline for discharge to the receptacle. A conveyor system is subject to much wear and requires frequent repair. Therefore, a standby conveyor should be available to assure reliable operation of the incinerator plant.

The quenching water from either system will contain dissolved salts and solids from the residue as well as micro-organisms which transfer from the ash. This quench water must be treated prior to final disposal or re-use. The quench water is usually of high pH which should be adjusted before delivery to a sewer system. Treatment facilities for residue waters are an important part of the incinerator operation.

We recommend the use of immersion type quenching.

Building and Grounds

The incinerator building should be attractive, but simple, economical, and functional. Today's public is conscious of the beauty of its surroundings. The incinerator plant of past years is frequently an ugly structure, but modern plants can be made attractive. The plant layout should consider that certain parts of the operation will be outside of the building, and efforts should be made to prevent these from detracting from the architectural beauty of the plant.

An incinerator is basically an industrial type of building. Normal industrial type of precautions and construction must be made in the design of the incinerator building. Interior walls and ceilings should be easily cleaned and designed for a minimum of maintenance.

The incinerator plant should contain facilities for the employees. Lunchrooms, locker rooms, and washrooms should be efficiently planned and well-designed for employee comfort. A separate washroom near the tipping floor will provide facilities for truck drivers and other transient personnel. Safety and firefighting equipment must be provided.

Pleasing and effective landscape is a must for the incinerator grounds. Shrubs and grass are relatively inexpensive and pay large dividends in public relations in the neighborhood and in the entire city. The layout of walks and driveways to eliminate as much cross traffic as possible is important. The incinerator grounds should be much larger than the building area requires to provide isolation from surrounding construction. Ten or more acres devoted to the incinerator grounds is desirable.

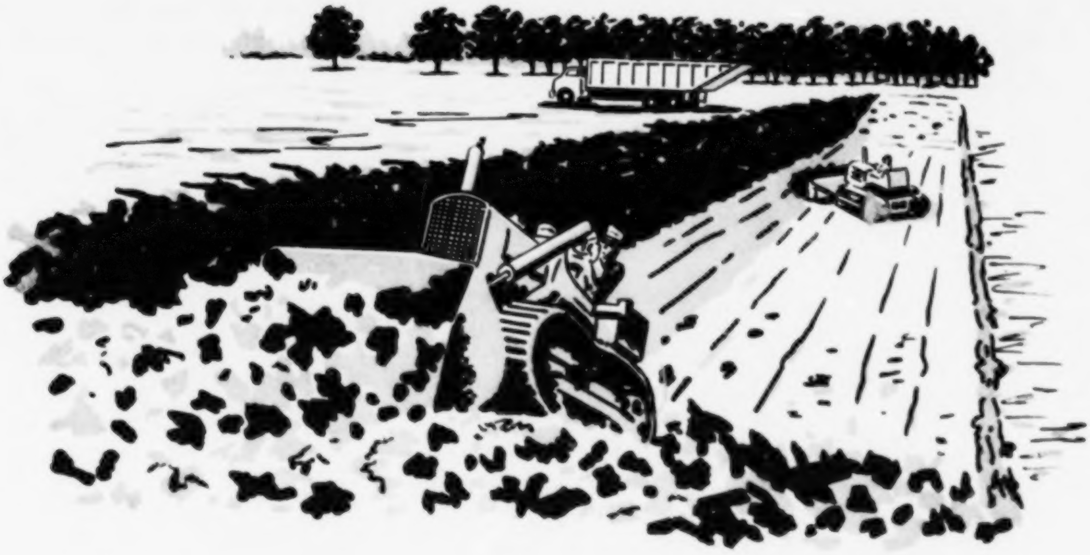
Recommendations

We have discussed the advantages and disadvantages of both refractory and water wall furnaces. The faults of each are known throughout the industry. Refractory furnaces are a proven form of refuse incineration whereas there has been little experience with water wall incinerators in this country. However, we believe the potential of the water wall is superior to that of the refractory wall. We believe the problems, particularly those of corrosion of walls can be overcome and that the water wall furnace has more to offer in the way of advanced technology and hence, more of a future than does the refractory furnace. If current experiments now being conducted in New York and elsewhere substantiate our faith, then we recommend water wall furnaces for Oakland County. If further testing does not overcome problems experienced with operating equipment, or new problems arise, then this recommendation must be reviewed at the time of design and the best furnace construction then available used.

Water wall furnaces permit smaller capacity air pollution control equipment. This equipment must be of high efficiency to meet existing codes, and should provide easy accommodation for restrictions in emission standards. We recommend the use of electro-static precipitators preceded by cyclone mechanical collectors for the Oakland County installations, unless current tests prove these units unsuitable for municipal incinerators. We believe that this will be the least expensive and most efficient form of air pollution control operation for the County incinerators and will eliminate the steam plume associated with the wet type of control devices.

We recommend that standby equipment be provided for the crane and that a continuous conveyor type residue removal system be used by the plant.

We recommend that an attractive building be constructed, and that the grounds be amply large to permit isolation from surrounding structures. The building and grounds should be attractively landscaped and carefully maintained.



RESIDUE DISPOSAL

The incinerator reduces the volume of material which is delivered to it. Because incineration is a reduction process, a certain amount of residue remains after the burning process is complete. This residue must be removed from the incinerator grounds and properly buried or otherwise adequately disposed of. The transportation of residue to a disposal area, whether on the incinerator site or away from it, entails the same problems as transportation of raw refuse to the incinerator. However, because of the volume reduction, the magnitude of these problems is generally less.

Residue Transportation

The transfer of residue from the incinerator to the disposal area means that some form of transportation system is needed. We have considered truck and rail for residue transportation for Oakland County.

Truck Haul

Most incinerators use trucks to haul residue from the plant to the disposal area. This method has been favored because it is familiar, operating personnel are readily available, the service and routing provided are flexible and the cost is reasonable. These factors remain whether the haul is fifty yards or fifty miles. The only difference would be the type of vehicle chosen.

If an incinerator site is purchased suitably large to permit on-site residue disposal, smaller trucks with open bodies could be used.

The chance of obtaining a suitable residue disposal area on the incinerator site is poor in much of Oakland County because of urban development or for other reasons. When residue cannot be disposed of on the incinerator site, it must be taken to a disposal area elsewhere for burial. Long distance hauling of residue requires more specialized equipment.

Large semi-trailer type trucks should be used for long distance hauling of residue. Maximum capacity of trailers should be 40 cubic yards to remain within Class A winter highway load limits. Large loads reduce the number of trips the equipment must make over the highways. Fewer trips will interfere less with traffic and reduce resident objection to the operation on the grounds of traffic hazard or noise.

Trailer bodies should be watertight to prevent leakage of quench water and resultant odor and nuisance problems. Rock type bodies without unloading doors or gates will provide satisfactory watertight service and odor problems can be further reduced by covering the residue with a tarpaulin while en route.

Wet residue is an alkaline material which can be quite corrosive. Trailer bodies should be constructed of steel to withstand chemical attack and minimize deterioration of equipment. Central Wayne Sanitation Authority and SEOCIA both report average residue truck life of about two years.

The tractor selected for the operation must be suitable for a 65,000 pound G.V.W. A tilt cab over engine model appears easiest for maintenance and maneuverability. All safety devices and heavy duty tires should be included on the tractor unit. The tractor should be equipped with special power train including high power engine and heavy duty transmission. The additional power will be required at the disposal site, where low speeds and high power requirements are needed to pull the loaded vehicles over the material deposited by previous trucks. In the interest of economy, both of maintenance and operation, a diesel engine should be supplied despite the higher initial cost of this unit. High capital cost is rapidly offset by lower fuel and maintenance costs.

Maintenance is an important function of the residue hauling operation. Safe operating conditions of the vehicles are an important part of any residue disposal schedule. Breakdowns are costly, both in time lost and in maintenance crew costs. Since breakdowns cannot be eliminated completely, additional vehicles must be provided to supplement the equipment needed to provide the minimum service.

The maintenance operation should include a washing and disinfecting operation. Outdoor units similar to those used in automatic car washes can be supplied on the incinerator plant grounds so that returning ash vehicles can be washed before reloading or storage. Washing trailers and tractors creates a clean appearance to the public, and reduces the corrosion of the equipment, preserving its life. The automatic washing equipment can be provided with odor control or disinfectant spray as well as the washing solution.

The equipment purchased for residue disposal can be operated most efficiently on a 24 hour per day basis. This will require that the vehicles be operating on highways both night and day, which may bring objections from the public along the route. However, the savings in the equipment and manpower cost obtained by round-the-clock operation are sufficient to justify this type of operation.

Rail Haul

Each incinerator is situated reasonably close to an existing rail facility. This permits easy routing for rail traffic between incinerator and disposal area with short haul truck transportation from incinerator to railroad and from railroad to disposal site.

Railroads are considered for residue transportation for many reasons. Rights of way are usually already existent and adequately isolated from most development to preclude objections. The responsibility for long distance haul is with the railroad, so that public responsibility is limited to loading and unloading operations and final disposal. The use of rail haul eliminates the need for several long distance truck drivers and maintenance of their equipment.

Rail transportation can be accomplished by direct haul in rail cars or by piggy-back rail combination.

Direct transportation in rail cars will require either covered gondola cars or covered hopper cars. Gondola cars should be of the side-dump variety, capable of unloading onto conveyors or into a hopper from which residue would be transferred to trucks for hauling to the disposal area. If hopper cars are used, these should be equipped with wide gate bottoms which can be opened for direct dumping into trailers or onto conveyors for delayed trailer loading. In either case, the operation on the fill site would be done by trucks because of their maneuverability and versatility.

Where piggy-back operation is used, we would recommend 40 yard rolloff bodies for residue receptacles. Rolloff bodies can be placed on flat cars or gondola cars for piggy-back operation to the disposal site. Special cabs and frames would take the bodies from the ash collection point at the incinerator to the train, and from the train to the dumping face at the disposal area. Rolloff bodies are less costly than standard wheeled trailers; thus, less money is invested in idle equipment awaiting transportation between disposal and incinerator site.

Rail cars or truck bodies used for handling residue should be covered to prevent odors and blowing ash.

Equipment used for rail haul should be maintained clean and sanitary, the same as that for truck haul. This will prevent undue deterioration of the equipment from corrosion and will present a better appearance to the observing public.

The cost of rail haul is about $10 per ton of residue hauled, according to prices offered by the railroad. This amounts to about 19 cents per ton mile, but rail haul may become less expensive in the future due to increasing labor costs for road haul.

Disadvantages of rail haul of residue within Oakland County include high cost; long cycle time, as much as three days per car; inflexibility of routing in the event of a disaster; lack of transportation control by the municipality and inadequate back up systems by the railroad to meet any major contingency. These disadvantages are not insurmountable but should be carefully considered before selecting rail haul as the primary form of residue transportation for the County under current conditions.

Residue Disposal Area

Residue must be transported to a suitable location for final disposal. This final disposal operation is similar in nature to a sanitary landfill. All of the principles of sanitary landfill including daily cover, protection of ground and surface water, confinement of residue, and compaction are important in the residue disposal operation.

Depressed areas such as natural ravines, potholes, or man-made pits provide an economical location for residue disposal. This does not imply that more level terrain cannot be used, provided the land is not part of a flood plain and normal precaution against contamination of ground or surface water is made. The site should have a readily available supply of cover material either contained on the site or suitably close for economical importation. The residue disposal site should receive the same consideration as a sanitary landfill receives for ultimate use development. The fill site should be properly engineered and planned to become an asset to the community rather than a detriment. Because of the character of the residue, a denser compaction with less future settlement can be achieved. This will provide a much firmer foundation for airport facilities, light industrial areas, recreational facilities or other anticipated uses.

Areas adjacent to lakes and streams or areas which have indication of development have not been considered as residue disposal areas. The first consideration is given to undeveloped land, isolated areas far from population and scenic beauty and removed from the extensive park and recreational areas of the County. Farmland received second consideration, but only when it was believed to be poor cropland or had been removed from active agricultural use. In such cases, the land could have greater economic value developed after it was used for residue than if left for the natural course of events.

There are many large tracts of land in Oakland County which appear suitable for residue disposal areas. We have investigated several sites which displayed the characteristics of a good residue disposal location. Our investigation considered the area of land available, an estimate of its capacity for residue disposal, the general type of neighborhood, road access and several other subjective items. We were able to select three areas for a large single site for futher objective evaluation with the plan for refuse disposal.

The three sites are located near railroads and are isolated areas of ground largely undeveloped and unused as land resources. One site is located in Addison Township and has an estimated capacity of 60,200 acre feet. The second site is located along the Orion Independence Township boundary and contains approximately 40,000 usable acre feet. The third site is situated along the Springfield-Rose Township boundary and contains 82,000 usable acre feet. We have made a comparative study of the economics of using each of these sites with the plans presented later in this Report. The site selected for residue disposal changes between the two plans. For this reason, no indication of the economic advantage of each site is presented here. Suffice it to say that such criteria as transportation time, road conditions, cost of vehicle operation, maintenance, added man-power and cost of the land purchased at each site were among the items considered in the economic comparison.

We do not anticipate extensive difficulties in using any of the three sites suggested. However, before any one site is finally selected, thorough sub-surface investigation of the territory should be conducted to avoid problems created by poor soils or high ground water.

We recommend a single large area of land for residue disposal. The large area will permit operations to continue at the same site for an extended period of time and allow construction of permanent buildings for equipment maintenance and minor repair. The land area need not be large enough for the entire project life. Two or more large sites may be obtained close enough together to allow common use of the maintenance building. Upon completion of operations in the area, the maintenance building may be sold for light industrial use if it is not needed further for County operations.

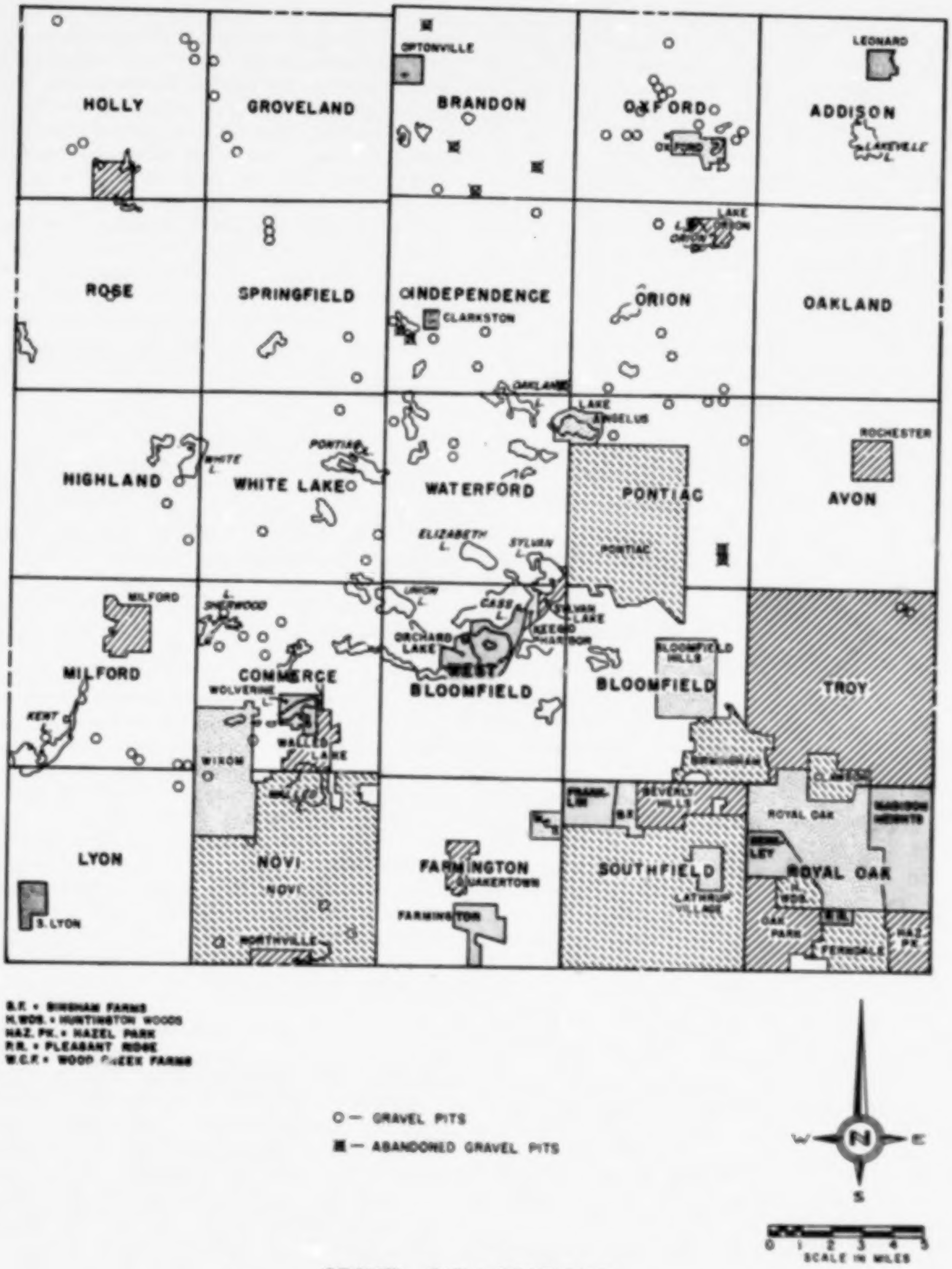
Gravel and Borrow Pits

Past studies of disposal areas in Oakland County have placed considerable emphasis on using the large gravel extraction areas north of Oxford. These areas are large volume depressions which would take many years to fill with residue from Oakland County. However, it is our opinion that these areas are not suitable sites for residue disposal at this time. Most of the area is currently in use. Some areas in which gravel operations have terminated permanently have been converted to lakes and the surrounding shoreline has been subdivided. The company operating the gravel operations has graded the land, planted grass seed, and has made considerable effort to beautify these areas. Certain portions of the gravel operations are under water. In these areas the operations are continuing by dredging gravel from beneath the ground water level. The use of these gravel pits for residue disposal would disrupt the operations, reduce their value to the company as a possible source of gravel at depths below those now existing, and remove the possibility of converting these to attractive home sites or recreational areas.

At some time in the future, it is possible that dry abandoned gravel pits will become a site for residue disposal. This will occur when the company ceases operations without an effort to reclaim the area. We believe that the gravel extraction operations will continue far enough into the future that we have not considered the active gravel pits as a residue disposal site for Oakland County.

There are currently in Oakland County many small dry abandoned gravel and borrow pits. These are shown on Figure No. 11. These pits disfigure the landscape and attract illicit dumping by local residents. Elimination of these pits by filling with residue can restore the natural beauty of the area and do away with attractive sites for local dumping. Many pot holes, sharp ravines and dead lake areas abound in certain areas of Oakland County. These too attract illicit dumping and are valueless from the standpoint of economic development. The owners of such sites may permit their use for residue disposal at little or no cost to the County.

Both the abandoned pits and the pot hole areas of the County could be used for residue disposal. The sites would be filled rapidly and the operation easily moved to another site in order to continue residue disposal. The versatility of truck transportation will make the use of these small areas more feasible. By using abandoned pits and pot holes as a residue disposal area, the County can reclaim land which now lies useless and beyond feasible development.


HOLLY
GROVELAND
BRANDON
ORTONVILLE
OXFORD
LEONARD
ADDISON
LAKEVILLE L.
ROSE
SPRINGFIELD
INDEPENDENCE
CLARKSTON
ORION
LAKE ORION
OAKLAND
HIGHLAND
WHITE L.
WHITE LAKE
PONTIAC L.
WATERFORD
LAKE ANGELUS
PONTIAC
ROCHESTER
AVON
ELIZABETH L.
SYLVAN L.
MILFORD
SHERWOOD L.
COMMERCE
UNION L.
CASS L.
ORCHARD LAKE
SYLVAN LAKE
KEEGO HARBOR
WEST BLOOMFIELD
BLOOMFIELD HILLS
BLOOMFIELD
TROY
KENT L.
WOLVERINE L.
WALLED LAKE
WIXOM
BIRMINGHAM
CLAWSON
FRANKLIN
BEVERLY HILLS
B.F.
W.C.F.
ROYAL OAK
MADISON HEIGHTS
LYON
S. LYON
NOVI
NORTHVILLE
FARMINGTON
QUAKERTOWN
SOUTHFIELD
LATHRUP VILLAGE
BERKLEY
H. WDS.
P.R.
OAK PARK
FERNDALE
HAZ. PK.
B.F. = BINGHAM FARMS
H. WDS. = HUNTINGTON WOODS
HAZ. PK. = HAZEL PARK
P.R. = PLEASANT RIDGE
W.C.F. = WOOD CREEK FARMS
○ — GRAVEL PITS
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SCALE IN MILES

GRAVEL PIT LOCATIONS

FIGURE 11

Residue Disposal Equipment and Design

Certain specialized equipment will be needed at the residue disposal area. The equipment must be capable of handling large volumes of residue and earth in order to perform satisfactorily the covering-compaction operations. Three major types of equipment are available for this operation; tracked equipment, wheeled equipment, and roller equipment.

Tracked equipment is the most common type of fill area machinery in current use. Tracked vehicles spread the vehicle weight over a large area, thereby reducing ground pressures and enabling the equipment to maneuver in areas too soft for other types of vehicles. Tracked vehicles have a large capacity for handling residue or earth. Examples of this type equipment are bulldozers, front end loaders and tracked cranes.

When used at a land fill or ash disposal fill site, the equipment should have undersized tracks equipped with cleats. The cleats will crush material left at the site and the narrower tracks will provide greater pressure. Tracked vehicles have a disadvantage in that the tracks easily become clogged with wire and other miscellaneous items found in residue. However, they offer a greater maneuverability and flexibility of operation over the entire fill site, particularly in poor ground conditions.

Wheeled vehicles incorporate the use of large cleated rubber tires in place of tracks. This equipment is also available in bladed buildozer type equipment, front loaders and earth moving pans. Rubber tires are susceptible to damage by materials in the fill. Reinforcing rods, steel pipes, wires, glass and other items can puncture the tires. Recent experiments using wire mesh tire cord in place of cloth fabrics have shown that this type of tire, though much more costly, reduces the frequency of tire failure. Rubber tired equipment can be driven over the highways, thus increasing its versatility when used with multiple small site residue disposal operations.

Roller type equipment is gaining popularity in sanitary landfill and residue disposal operations. The SEOCIA operates a roller type vehicle at its residue disposal facility. This type of vehicle is a steel wheeled tractor with cleats attached to the wheel to enhance compaction. The roller type equipment is suitable only for fill use and running on firm ground. It is very easily rendered useless in muck, mire and peat and cannot be used on the highways. Roller type equipment achieves a high degree of compaction, thus conserving the volume available for residue disposal.

The inability to travel over highways with tracked and roller type equipment is not a complete detriment to their use. The disadvantage can be overcome by hauling these vehicles on lowboy tractor trailer rigs from site to site. This method is similar to that used by contractors in hauling heavy equipment over the highway system.

Bulldozers used at the residue disposal site should have a capacity for handling approximately 250 to 300 tons of residue per 8 hour shift. For the size of operation anticipated for Oakland County, any units smaller than this will waste both equipment and manpower in inefficient operation. Larger equipment can be used if desired. Front loaders should be the largest available and should be equipped with buckets which can also act as blades or clamshells. This type of bucket will permit equipment to pick up and maneuver bulky items received at the site.

We recommend that a self-loading scraper pan be used to haul and spread cover material over the completed fill. This piece of equipment will be a rubber tired vehicle with a minimum capacity of 10 cubic yards of earth. The self-loading feature will permit the equipment to excavate trenches without the aid of a secondary bulldozer to force material into the pan. Soil types encountered at the proposed disposal sites are suitable for using self-loading equipment. The loaded vehicle on tires will also aid in compacting the residue as it travels over the completed fill spreading its load.

Miscellaneous Uses for the Residue Area

There are certain types of materials which are unsuitable to feed into an incinerator plant. These materials must be handled at a landfill site if they are delivered in their original form. These items include hot water tanks, stoves, refrigerators, tree stumps and tree parts, construction debris, demolition waste and other bulky or hazardous items.

Certain areas within the fill site should be specified for disposal of construction and demolition debris. This material is difficult to handle and damaging to the tracks or wheels of the landfill equipment. It can be covered on occasion but does not necessarily require daily cover. Construction debris and clean demolition debris can be used to fill low marshy land below the water table provided it is free of organic or putrescible matter. Stoves, refrigerators, freezers, hot water tanks and other similar bulky appliances can be best disposed of at the landfill. The alternative of passing these through a hammermill operation and feeding through the incinerator is more costly and damaging to equipment than simple burial. A special site should be selected at the residue disposal area for burial of this type of appliance.

Much of the hazardous wastes, oils, and other volatile liquids are now being sent out of the County for treatment and disposal. Much of this material is burned in a special privately owned incinerator in McComb County. This practice should be encouraged, but the landfill area should be prepared to receive small quantities of those materials from small firms or individuals. Proper disposal could be burial in sealed drums or other containers encapsuled in concrete to prevent the metal containers from corroding away. These areas set aside for wastes requiring special handling techniques will provide the County with a complete disposal system.

Hazardous wastes, oils and chemicals which are not sent out of the County by their producers to be reclaimed can be buried with proper precaution at the residue site. A separate area should be provided for this service. These areas set aside for wastes requiring special handling techniques will provide the County with a complete disposal system.

Recommendations for Residue Disposal

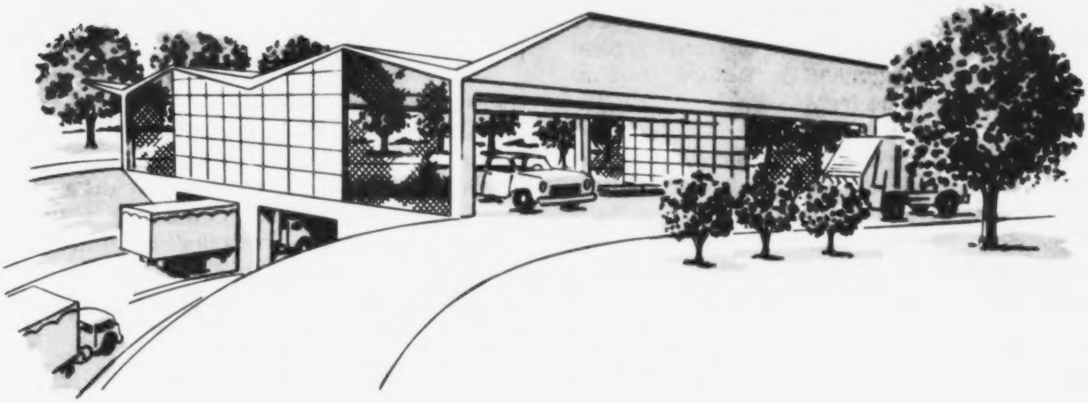
Residue leaving the incinerator can best be handled by over-the-road transportation facilities. Highway transportation is less costly, more versatile and more flexible than rail transportation. Highway transportation will permit ease in moving from site to site as small residue disposal areas become filled.

Three large single disposal areas were selected in the County for consideration with each of the plans studied and presented later. The recommendation for a disposal area is included with the discussion of the plans.

The County abounds with local abandoned gravel or borrow pits and with potholes. These areas are of no current economic use and can be reclaimed by using them for small residue disposal areas. The life of such sites may extend from a few weeks to a few months, but the value of the reclaimed land would offset the cost of moving equipment from site to site.

The residue disposal area should be equipped with heavy tracked equipment and pans of adequate capacity and suitable ruggedness for use in residue fill operations.

The current practice by industry of special and hazardous wastes disposal through private operations should be encouraged. However, small quantities of these wastes will probably be brought to the residue site for final disposal. Such wastes should be disposed of in special areas and by the use of safe methods in accordance with the characteristics of the particular types of waste.



SECONDARY TRANSPORTATION

The transportation of refuse from collection districts to the incinerator can create several problems. Much valuable equipment is ineffectively employed in taking collections to the place of final disposal. Frequently, the men working the collection route accompany the refuse truck to the disposal site, increasing the ineconomies of using route trucks for long distance haul. A secondary transportation system can provide a place for trucks to unload near their routes and eliminate the need for long distance hauling in small vehicles.

Route vehicles create traffic congestion in the vicinity of the incinerator. Operations the magnitude of those proposed for Oakland County will impose traffic loads at each disposal site. A secondary transportation system will help alleviate this problem by providing a place for route trucks to unload away from the incinerator. A few bulk transportation units would then take refuse to the disposal site to complete the relief of traffic problems.

Transfer Stations

A transfer station is the facility where refuse is unloaded from collection vehicles and placed on other forms of transportation for a more economical haul to the disposal site. The transfer station will receive solid waste from passenger cars, industrial trucks, and other private delivery vehicles in addition to the route trucks.

Station efficiency is a primary design consideration. The number of vehicles entering a station at any given period of time must be able to unload with a minimum of delay. Station and transportation equipment must be reliable and adequate reserve or standby equipment must be available to handle emergencies.

In the northern climates, the station should be roofed or enclosed. Enclosure prevents the accumulation of rain water or snow on the dumping floor. It also helps prevent unsanitary conditions and restricts the blowing of paper. Dust control facilities should be provided.

The transfer station must be attended. Since both transient and regular personnel will be at the site, facilities for their convenience should be a part of the design. The transfer station should have a restroom area and a potable water supply. Scales should be available at the transfer station site to weigh both incoming or outgoing loaded vehicles.

The transfer station should be kept as simple as possible. Simplicity provides a system more reliable than a complicated station and is easier to maintain. Direct dumping from the route vehicle onto transport equipment is suitable for all transport systems considered.

The transfer system must be designed to meet all foreseeable contingencies. The transfer station must have adequate capacity in both access and transport volume and must be economical to operate. The operation which can meet these criteria best today may be replaced by a more efficient operation in the future. Because of this possibility the system designed should be capable of modification and expansion as required with as little disruption of service as possible.

Transfer stations designed to accommodate other forms of transportation than that proposed initially will permit a more flexible system capable of longer and better service to the Oakland County community.

Transfer Station Location

The location of a transfer station will be influenced considerably by the method of transportation used. The economics of hauling by collection truck must be compared to the cost of hauling by bulk carrier plus the cost of operating and maintaining the transfer station. The type of secondary transportation is an important consideration in locating transfer stations. Existing systems will be improved and new ways to handle refuse will be developed. The location of the transfer station must allow for changes in transportation method if economics justify such a change.

The transfer station should be located as near the center of production of its service area as possible. It should be situated near a good primary highway leading to the disposal area and connecting roads should be hard surface all weather roads of Class A standard of the County Road Commission. Some highway improvement will be necessary to meet this consideration. Railroad service should be available on the site, or reasonably close so that a spur track can be constructed if rail transfer is used. The station location must minimize objections by surrounding residents. Industrial or agricultural areas are best.

The ultimate consideration in locating transfer stations, or deciding if they are needed at all, is economics. Travel time is an all important factor in this decision because it relates to distance for truck travel, but that distance can vary under differing road conditions. If the cost of driving route trucks to the disposal site from a given location is greater than the cost of operating a transfer station and bulk carrier system, then the transfer station is justified.

Bulk Transportation Systems

Bulk transportation of refuse in quantity is the purpose of secondary transportation. Bulk transportation reduces labor costs and provides a feasible method of moving large amounts of solid waste between points. Large trailers, railroad, pipeline and conveyors are being considered for refuse transportation. Each method is discussed in the following paragraphs.

Road Transport

Transfer of refuse from a collection area to the disposal site by road is the most popular method. Roadways are already available in most areas and no special equipment maintenance is needed. Truck transportation offers the advantage that a breakdown is readily overcome by substitution of another piece of equipment. Road transportation does not depend upon a single route. In the event a route is disrupted by construction, bridge failures, flooding, or for any other reason, a substitute route is usually available and the system can continue to function. Unloading equipment at the disposal area required for truck transportation is simple and inexpensive. These factors reliability, adaptability, simplicity, and reasonable cost combine to create the popularity of road transfer.

Transportation of refuse by highway is not free of problems, however. Some existing roads are unsuitable for heavy truck traffic required by transportation of refuse. In these instances, the road surfaces must be improved before service begins. Refuse transportation on the roadways of Oakland County will add to traffic. If the haul routes pass through residential areas, local home owners will complain that the added traffic creates a hazard to their children. Complaints may also cite truck traffic as the cause of plaster cracking in homes regardless of the actual cause, and twenty-four hour hauling operations may result in complaints that traffic noise prevents sleeping. When the haul route is over well-traveled highways, the complaints will be less severe and frequent. However, some adverse reaction can be expected from people using these roads. Their chief complaint will be that the heavy truck traffic has slowed their normal travel time over the route.

Open Semi Trailers

Open trailers have been used for refuse transportation in the past. They are economical, simple, and provide good service. They must be covered by tarpaulins during operation over the roads to prevent blowing debris and reduce odor problems.

Open trailers are of many types including open top semi trailers, open rear dump sand type trailers, and open top side dump trailers and low boy semi trailers with containers. Semi trailers and low boy container trailers require an independent machine for unloading; the dump trailers do not need help to unload. The trailer capacity should be between 70 and 80 cubic yards for open type trailers. Three axles will be needed.

Refuse arriving in packer type collection vehicles will be partially compacted, but much material will be loose. Some compaction can be obtained by using backhoe machines to push loose refuse down into the trailer. The same machine can help distribute the load in the trailer or aid in loading bulk items. Compaction in large open trailers cannot be too great or highway weight restrictions will be exceeded.

Compactor Trailers

Much of the popularity of compactor trailers comes from the belief that more refuse can be hauled in these than in open trailers. It is true that several route truck loads can be hauled in a small volume, but the weight restrictions on highway use limit the loads to about the amount that can be hauled in open trailers. Compactor trailers are totally enclosed and self unloading.

During this investigation we observed operations and talked with personnel at the Dearborn, Lincoln Park, and Plymouth Road transfer stations in the Detroit area. The Lincoln Park unit uses compactor trailers and stationary compactors and Dearborn uses compactor trailers to increase load capacity of their vehicles. Operating reports of these two stations and discussions with the operators indicate that compactor equipment is subject to frequent mechanical breakdown and is very costly to operate and maintain. The main difficulty lies with the compactor trailer itself. The hydraulic system is subject to failure, and if refuse jams behind the pusher plate of the trailer, that unit must be removed from service for repair. Operators told us that these repairs can take as much as 48 hours. In the meantime, refuse piles up and is usually stored in the open behind the transfer station. Such operation can create nuisances of blowing papers and odors, and may create health hazards through vector harborage. We conclude from the investigation that the use of compactor type transfer vehicles will be unsatisfactory because of the high maintenance and operating cost associated with them, and because of the difficulty in keeping vehicles in service.

Rail Transportation

In the 1964 report by the Detroit Metropolitan Area Regional Planning Commission, railroads were considered for secondary transportation of refuse. That study emphasized the use of flat cars to piggy-back transport vehicles. The existing rail system would be capable of carrying refuse from the Metropolitan Region to the landfill site proposed in northern Oxford Township.

Railroads offer an attractive means of refuse transportation. Railroad rights-of-way are normally isolated from the residential and commercial communities. Because of this isolation, noise and traffic problems created by the heavy flow of refuse cars do not disrupt the everyday living of the neighbors. Dust and seepage from the full refuse cars along the right-of-way are less of a problem than along a major highway. Rail and highway crossings at major highways are frequently separated, so that rail traffic creates a minimum of inconvenience to the public. Railroads permit the highways to remain more available for automobile traffic by eliminating the numerous trucks which would pass through certain streets and roads in a road transport system. Less manpower and fewer vehicles are required if railroads are used to do the major portion of the refuse hauling.

Railroads can create problems to a short haul refuse transportation system. Drivers and vehicles are needed at each end of the rail haul to load and unload the transport trailers, if the piggy-back system is used. If direct haul by rail is preferred, the unloading equipment is much more complicated than is required for piggy-back or truck transport. In this case, unloading equipment, vehicles or conveyor systems must be provided at the incinerator site, and the equipment provided to spot rail cars for unloading. The use of railroads for long haul distances will probably be justified, however.

The volume of refuse handled by individual transfer stations in Oakland County is low enough so that trains would probably be run once a day only. Refuse would remain in the hauling vehicle for about 24 hours, and additional time is required for the return trip. The result of such longtime delay is that each trailer could be used only once in the cycle time. Therefore, a large number of piggy-back trailers is required, or enough rail cars to provide adequate capacity plus reasonable standby must be available. Batch delivery to an incinerator site is more of a problem than at a landfill because a large storage pit is needed at the incinerator to accommodate large deliveries, or else enough trackage must be provided to permit storage in the rail cars.

The present railroad pattern is not suitable for secondary transport of raw refuse. It will be necessary to construct extensive connecting rail lines to make this form of transportation feasible at this time.

Even if rail transportation were readily available and the other difficulties surmountable, rail haul would still have several major disadvantages. The control of the system is in the hands of the railroad and not the county; rates and charges can be changed without consultation with the county. Further responsibility for meeting delivery schedules rests entirely upon the railroad with little recourse on the part of the public for failure to meet that schedule. In the event of a mishap such as derailment, strike, or other natural or man-made disruption of service, the community is without secondary transportation.

The railroad's solution is to stockpile the material until service is restored. For short disruptions in service, this is a satisfactory method of handling the problem, but in the event of one or more days with no rail service, road transportation facilities will have to be rapidly provided for adequate interim service. This means that sufficient, suitable road haul vehicles must be available within a reasonable distance and time of Oakland County. The reliability of the railroad transportation system should be carefully considered before a decision is made to use this method.

Piggy-back transportation for railroads is not the only available means for rail hauling refuse. The concept of baling refuse and hauling it in freight cars is being considered in Chicago and New York. Refuse is handled as any other boxed or baled commodity. Covered hopper cars are also a possible way to haul refuse by rail. In most instances, the refuse must be preprocessed by grinding or baling prior to hauling in the rail car.

Pipeline Transportation

The use of pipeline for secondary transportation is a recent innovation. Extensive investigation is being conducted at the University of Pennsylvania and elsewhere in search of a low-cost, reliable method of transporting refuse by pipeline. The investigations have been conducted on municipal refuse that has been run through a grinder and slurried for transportation. A paper presented by Mr. Iraj Zandi and Mr. John A. Hayden to the American Society of Civil Engineers concludes that over a long period of time, pipelines will be more economical than the present road transportation system.

There is no dust, dirt, or filth resulting from the transportation itself, although these problems may arise at the station where refuse is transferred from route vehicles to the pipeline. The material forming the slurry must be dried at the disposal site for handling. The drying will require the use of centrifuges and will permit some use of waste heat from boiler cooled incinerators. The experience at the University of Pennsylvania indicates that the municipal refuse when relieved of large, heavy objects such as iron bars, bicycle frames, sign posts, etc. can be passed with ease through the pipelines with little clogging. Water is used to create the slurry in the pipeline, this being a relatively inexpensive and widely available commodity in Oakland County. Pipelines can be buried at shallow depths interferring with neither underground structures nor traffic.

Pipeline transportation has some disadvantages to offset the advantages presented above. The inability to transport large metal objects has already been indicated, although glass bottles and tin cans have successfully passed through both the grinder and the pipeline at the University of Pennsylvania. The experiments thus far have been confined to pipe sizes of 6" or less and have not been on a scale suitable for consideration in a transportation system similar to that required by Oakland County. The water used in slurrying the refuse must be reclaimed in order to maintain the economy of the system over a long period of time. The reclamation consists of settling with some final treatment before disposal, with makeup water being added to the system as required. No clogging of the pipeline system at bends was experienced in the University of Pennsylvania operation, but they indicated that some difficulty was observed at valves.

Our studies indicate that the cost of pipeline transportation is less than that of any other transport system. However, the embryonic technology of pipeline transportation prevents us from recommending this method of secondary transportation for Oakland County. Should the technology of pipeline transportation advance rapidly enough so that promise of a trouble-free system is apparent at the time of construction of the facilities proposed in this Report, then pipeline transportation should be reinvestigated as a transportation method.

Conveyor Transportation

The use of conveyors to transport refuse was explored during this study. Investigation included both elevated and underground conveyor systems. Of the several types of conveyor considered the most suitable type of equipment currently available on the commercial market is a belt conveyor.

Conveyor transportation offers advantages similar to those of rail and pipeline transfer. Conveyors relieve the road system of the heavy truck traffic usually associated with refuse transportation. The conveyor system can be placed underground or where it is hidden from the view of the local citizenry, or it may be placed at ground level or above, in which case it becomes a visible part of the landscape. Conveyors have the ability to traverse various types of terrain and can be designed to change direction. Noise, dirt, and other problems will not be a major consideration in transportation by conveyor, but will still be present at the transfer station or the point of discharge.

The disadvantages of conveyor equipment are many. Conveyor equipment currently comes in limited sizes and is generally unsuitable for long distance transportation. Belts are limited in length and conveyors must be combined in a series, in order to make a multi-mile transportation system operable. Conveyors are subject to wear and breakage and must be replaced on occasion. Standby or emergency transport equipment must be available in the event of such breakdown. Fire hazards on a belt due to burning refuse brought to the transfer station by a truck is always a possibility. A fire in either a tunnel or in an elevated conveyor housing is difficult to control and extremely dangerous. If overhead conveyor systems or surface conveyor systems are used, the housing is not attractive and will be a detriment to nearby property values. Many safety problems occur with the use of conveyors, such as personnel having limbs caught in machinery, long objects projecting from the belt injuring personnel, etc. The cost of refuse transporation by conveyor system is quite high in relation to the other methods investigated. These disadvantages relate to currently available conveyor equipment.

Refuse transportation in the future may become more economical by conveyor. Monorail conveyors, similar to monorail train systems, may be available for transporting baled or otherwise packaged raw refuse. It is even conceivable that a refuse transportation system could be incorporated into a system of public transportation.

Economics of Secondary Transportation

The cost of operating a transfer operation must be paid for in savings realized from reducing non-productive time for route vehicles. The example below illustrates this point.

The cost of operating a 20 cubic yard packer-collection vehicle will amount to about $150 per day for sinking fund, operation and maintenance and a 3 man crew. We have assumed the truck will be driven 50 miles per day including disposal of 2 loads. At an average weight of 400 pounds per cubic yard and two loads per day, the vehicle handles 8 tons per day. The cost of operating the collection truck is about $19 per ton. If the round trip haul distance is increased 20 miles, the added operating cost per day will be $4 and the time lost in travel 1.6 hours, assuming an average speed of 25 miles per hour for the truck. The truck will be limited to collecting about 1-1/2 loads per day, or 6 tons. The cost per ton would be about $25.60. The difference of $6.60 per ton could be spent on a secondary transportation system.

We have used the transfer station, disposal site locations and quantities from Plan A under Proposed Solutions to formulate estimated costs for the various methods of transportation. These costs reflect current costs for equipment, labor, operation and maintenance. Each system is compared on the same capacity and terminal points; routings were not necessarily the same. The comparison is as follows:

Type of Transportation	Cost Per Ton	Cost Per Ton Mile
Road Haul	$ 6.38	$0.12
Rail Haul	10.00	0.19
Pipeline	6.05	0.14
Conveyor	25.39	0.43

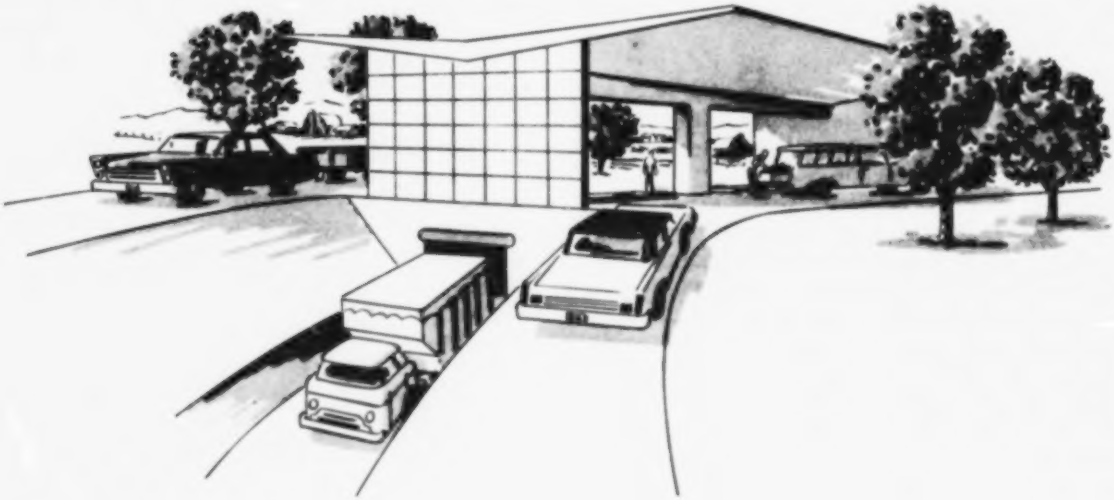
Recommendations on Secondary Transportation

Our present recommendation is that road transportation be used in Oakland County. In order to facilitate other methods of transportation, most transfer station locations are near a railroad. This will permit conversion to rail haul for secondary transfer if this method becomes more feasible in the future. Pipelines can also be used if this method is more economical from the proposed transfer station locations. In both cases, modification of the proposed transfer stations would be required to facilitate the new form of transfer. The proposed transfer station dimensions are large enough that this can be done without major alteration to the buildings.

Transfer stations designed to accommodate other forms of transportation than that proposed initially will permit a more flexible system capable of longer and better service to the Oakland County community.

The truck-trailer units should be self unloading non-compacting trailer rigs. The trailer itself should be of the side-dump variety whenever provision for this design can be incorporated into the incinerator. Truck units should be rated for 65,000 pound gross vehicle weight (G.V.W.).

The transfer station should be neat and clean in appearance, the grounds landscaped and kept mowed. Operating personnel at the station should take pride in their working location and maintain it in an attractive and nuisance-free sanitary condition at all times in order to minimize the concern of neighbors. The transfer station should be equipped to handle adequately the volume of refuse which will be brought to it, provide facilities for the personnel and a scale to weigh the material coming to the station.



THE RURAL PROBLEM

Problems created by local practice of refuse disposal in rural areas differ from those of the municipality. Heavily urbanized and suburban areas generally are sufficiently populated to make house to house pick up economical. In contrast, rural areas contain large areas of open space. Scattered homes increase the cost of pickup so that it is unusual to have collection from all homes in rural areas.

The following townships are considered rural areas: Addison, Brandon, Groveland, Highland, Holly, Independence, Lyon, Milford, Novi, Oakland, Orion, Oxford, Rose and Springfield, including villages within each.

Vast areas of these townships are undeveloped and approximately 50% of the Township area is devoted to agricultural use. The rural townships listed above do contain some areas of urbanized development such as the villages of Holly, Oxford, and Lake Orion or the suburban areas now projecting into Independence Township. Despite the fact that the urbanized areas are populated enough to justify public refuse collection and disposal, they are included in the rural area because of geographic location. The discussions that follow regarding rural refuse problems deal primarily with the non-farming rural residential and privately owned cottage developments. Occupants of most farms practice reasonably good refuse disposal on their own land.

Information obtained from the Oakland County Planning Office indicates that in 1963 the fourteen rural townships contained 22,117 residential units of all types. This is an average of almost 44 residences per square mile. Three hundred eighteen of the mile square sections within these 14 townships held less than 20 residential units per section. In terms of collection there are about 22 stops per average mile in all fourteen townships and 10 or less in 2/3 of the sections contained within these townships.

Many rural residents are unwilling to employ a private hauler to dispose of their refuse. An individual owner or home resident can dispose of his own refuse in several ways. He may bury it or burn it in a back yard burner, which is usually acceptable in rural areas and is sufficient to prevent abnormal health hazards. However, these methods are limited to small household items. Larger items, such as automobile hulks, refrigerators, or stoves, must be handled differently.

The ultimate solution to rural problems will be achieved when every refuse producing premise is provided with collection under a township or county controlled program.

Many individuals do not practice either sanitary or thoughtful refuse disposal. They dispose of their waste along the roadside or a stream, as illustrated by the photographs on the opposite page. Each of these illustrated private dumps are found in Oakland County. Often, when started by one thoughtless individual, they are visited by others looking for a place to throw their trash and in time become quite sizeable. Adding to the problem in Oakland County, is the abundance of transient residents -- those persons who own or rent cottages or other recreational facilities in the County and live elsewhere. These people are often prone to ignore refuse collection by private haulers and take refuse with them when their brief stay in the County is over. This refuse is carried in the car to an isolated spot on the back road and thrown into the brush or onto a roadside dump which has been started by another individual. This unsightly and unsanitary practice must be stopped. We discuss methods whereby this can be accomplished later in this section.

Open burning in backyard burners reduces the volume of refuse to be disposed of by the home owner. However, the Air Pollution Control Act of 1965 and the implementing rules and regulations could be extended to the more rural areas and prohibit backyard burning. The practice of backyard burning and leaf burning in the open has been stopped in much of southeastern Oakland County. If backyard burning in rural areas is prohibited by future attempts to control air pollution, the volume of refuse which individuals must dispose of will increase. The individual will have to find a means to remove the unwanted material from his premises for disposal at an approved location, or he will take it himself to a roadside dump.

Bulk items and automobile hulks are particular problems. Bulk items consist of refrigerators, stoves, mattresses, springs, automobile seats, and other similar items too large for easy disposal by collection truck. In many locations throughout the County one sees numerous examples of bulk item disposal along roadsides or in creeks.

Automobile hulks similar to photographs on the facing page are scattered throughout the County. We have estimated that a minimum of one abandoned automobile body exists per square mile and we believe this estimate of 910 hulks is very conservative. These items, together with roadside dumps, are eyesores for the passing motorist and certainly cannot be considered attractive by local residents. A good and effective means of permitting the disposal of these items through the County Agency in cooperation with private disposal facilities is needed.

Disposal Methods for Rural Areas

Rural residents want their refuse disposal service improved. The absence of disposal sites in some townships or a single, infrequently open, public site in others is tolerated by rural residents, but they are not satisfied. Individuals interviewed while they were using rural dumps indicated a reluctance to travel more than 4 miles to a disposal site. Sparse facilities and severly limited hours at disposal sites tend to encourage roadside disposal and other littering practices.

We have explored two methods of final disposal for rural areas – convenience centers with final disposal at county solid waste facilities, and sanitary landfill. The two methods are compared on a basis of equal service. Travel distances are restricted to a maximum of about four miles so that 39 rural disposal points will be provided in the rural townships. Disposal points will open for 12 to 16 hours daily to provide convenient operation for most citizens.

Convenience Centers

A convenience center will provide a clean, sightly place for rural residents to dispose of their wastes. The center would be enclosed to prevent blowing paper and roofed to keep the weather from the user and the deposited material.

All-weather roadways would allow easy traffic movement in all seasons.

The convenience center would contain 20 cubic yard to 40 cubic yard portable sanitary containers in which the public could deposit their refuse. The facilities would be primarily for use by individuals and commercial establishments hauling their own waste, but one or two could be constructed large enough to permit private haulers to use them as a transfer station. The portable containers would be emptied daily and their contents taken to the incinerator or to a large county operated sanitary landfill.

Convenience centers would be visited three times daily throughout the week by county crews. A pick up vehicle would collect filled and partly filled containers and take them to a transfer station or a disposal site. The pick up vehicle would make at least two visits daily. A two man clean up crew would visit each unit once each day in a special truck to keep building and grounds clean and neat. The facility would not be attended except for these visits.

Each clean up area would be provided a truck equipped with a portable steam generator suitable for steam cleaning and applying a deodorizing agent if needed. A small insecticide spray unit and water tank could be provided. The truck bed should contain enough room to haul lumber and large bulk items that cannot be placed in the containers. A front loader attached to the truck would greatly aid the clean up operation.

The container pick up vehicle operator would be responsible for seeing that adequate numbers of clean empty containers are supplied each center. Each container should be steam cleaned before it is returned to service after each emptying. The containers would be roll off units, as illustrated in Figure No. 12, or commercial containers.

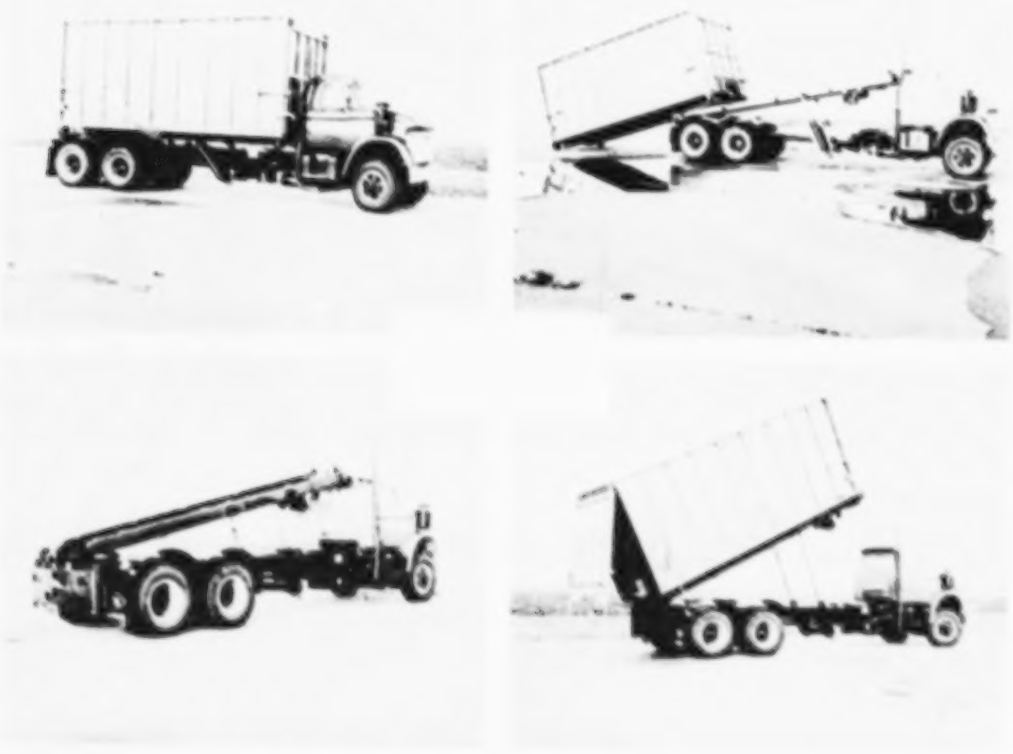
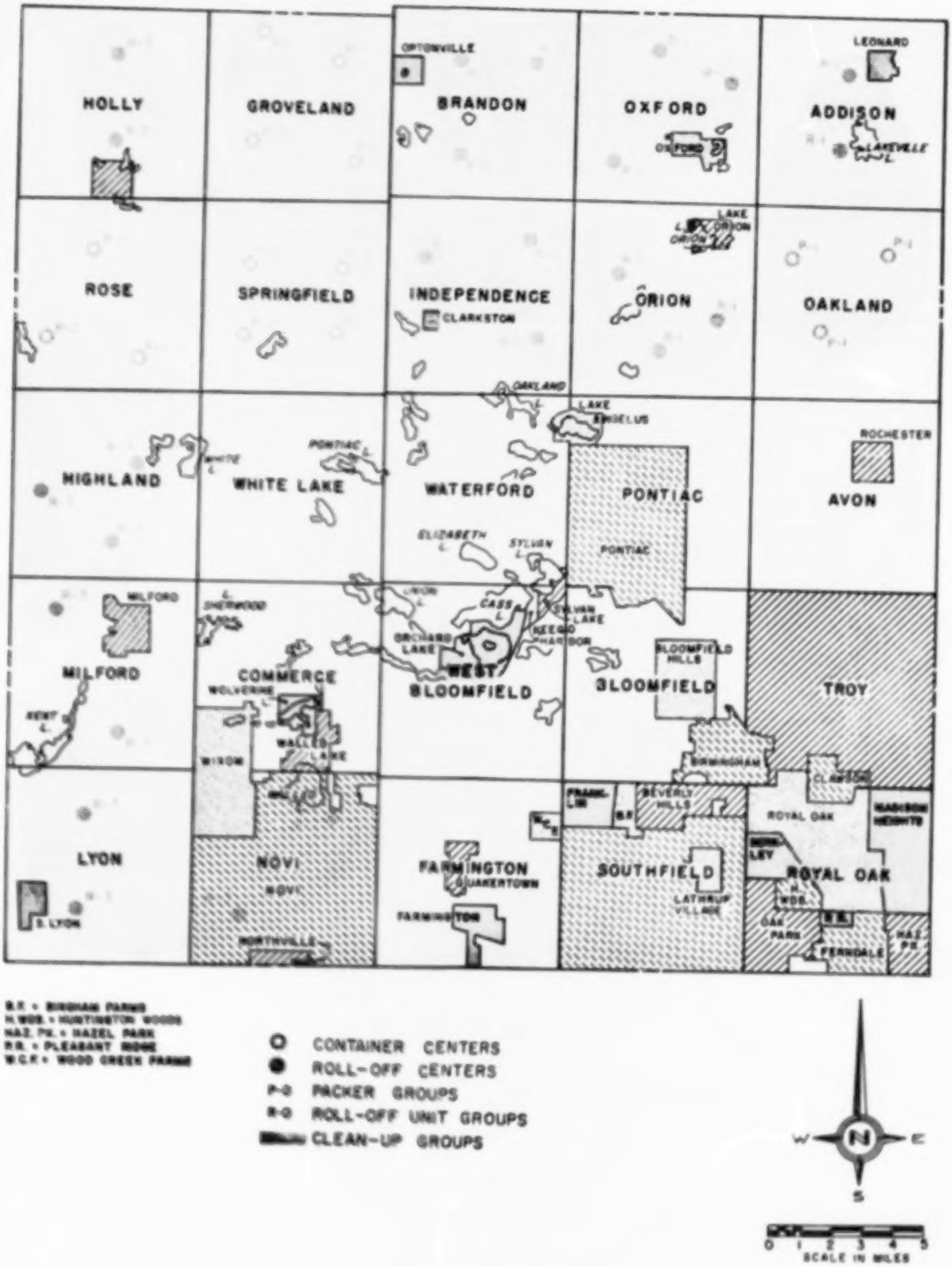


FIGURE 12


HOLLY
GROVELAND
ORTONVILLE
BRANDON
OXFORD
OXFORD
LEONARD
ADDISON
LAKEVILLE L.
ROSE
SPRINGFIELD
INDEPENDENCE
CLARKSTON
LAKE ORION
ORION
OAKLAND
P-1
OAKLAND L.
LAKE ANGELUS
HIGHLAND
WHITE L.
WHITE LAKE
PONTIAC L.
WATERFORD
PONTIAC
PONTIAC
ROCHESTER
AVON
ELIZABETH L.
SYLVAN L.
MILFORD
MILFORD
SHERWOOD L.
UNION L.
CASS L.
SYLVAN LAKE
KEEGO HARBOR
ORCHARD LAKE
COMMERCE
WOLVERINE L.
WEST BLOOMFIELD
BLOOMFIELD HILLS
BLOOMFIELD
TROY
KENT L.
WALLED LAKE
WIXOM
BIRMINGHAM
CLAWSON
FRANKLIN
B.F.
BEVERLY HILLS
W.C.F.
ROYAL OAK
MADISON HEIGHTS
LYON
NOVI
NOVI
FARMINGTON
QUAKERTOWN
FARMINGTON
SOUTHFIELD
LATHRUP VILLAGE
BERKLEY
ROYAL OAK
H. WDS.
OAK PARK
P.R.
FERNDALE
HAZ. PK.
NORTHVILLE
S. LYON
B.F. = BINGHAM FARMS
H.WDS. = HUNTINGTON WOODS
HAZ. PK. = HAZEL PARK
P.R. = PLEASANT RIDGE
W.C.F. = WOOD CREEK FARMS
○ CONTAINER CENTERS
● ROLL-OFF CENTERS
P-0 PACKER GROUPS
R-0 ROLL-OFF UNIT GROUPS
CLEAN-UP GROUPS
W
N
E
S
0 1 2 3 4 5
SCALE IN MILES

CONVENIENCE CENTER GROUPS

1970-1980

FIGURE 13

Figures No. 13 and 14 depict the location of proposed convenience centers and the grouping of units served by each container pick up truck and each clean up crew. Six container pick up trucks and eight clean up crews and trucks will be needed for the 1970 program to serve 39 sites in the fourteen rural townships.

Convenience centers, excluding the cost of incineration and residue disposal, are inexpensive to operate. Our estimate of capital cost of convenience centers to serve the fourteen rural townships is $1,648,400. The annual operating cost will be $1,818,800 in the decade from 1970 to 1980 and $2,249,900 in the decade beginning in 1980. The annual cost includes amortization, labor, maintenance and operating costs, but does not include the cost of incineration and final disposal. Incineration and final disposal will add approximately $560,000 to the annual cost in the first decade, which will bring the annual cost of convenience centers to $2,378,800. The cost of final disposal will increase to approximately $1,300,000 in the second decade, bringing the total annual cost for operating convenience centers to $3,549,900.

Sanitary Landfill

Traditionally, open dumping has been the method of solid waste disposal in rural areas. Consideration of sanitary landfills to replace these open dumps is a natural outcome of the passage of Public Act 87.

Sanitary landfills are an acceptable means of final disposal of solid waste. The County agency for solid waste disposal would be the logical place to concentrate authority for sanitary landfills to maintain uniform county-wide standards of good operation.

With county-wide operation of a landfill program, the 39 sites could be kept open for public convenience over a 12-16 hour daily period. An attendant would serve each site, directing traffic, picking up blowing papers and doing other general site maintenance during the day. Cover and compaction would be provided at each fill by a crawler tractor front end loader unit suitable for short haul of cover. Each tractor could serve all sites in a township by being hauled from site to site on a low-boy semi-trailer driven by the loader operation. A dump truck operator would accompany the dozer operator to haul cover or to do cleanup and maintenance work. The tractor would be at each site for a period of about 1-1/2 hours daily.

We have estimated the cost of operating 39 sanitary landfill sites in the fourteen townships. The estimate is based on keeping each site open seven days a week. The annual cost of operation in this manner will be approximately $2,241,600 in 1970-1980 decade including the cost of labor, equipment, land maintenance operation and amortization over a 20 year period. The cost will increase to $3,176,700 in 1980 to 1990 decade.

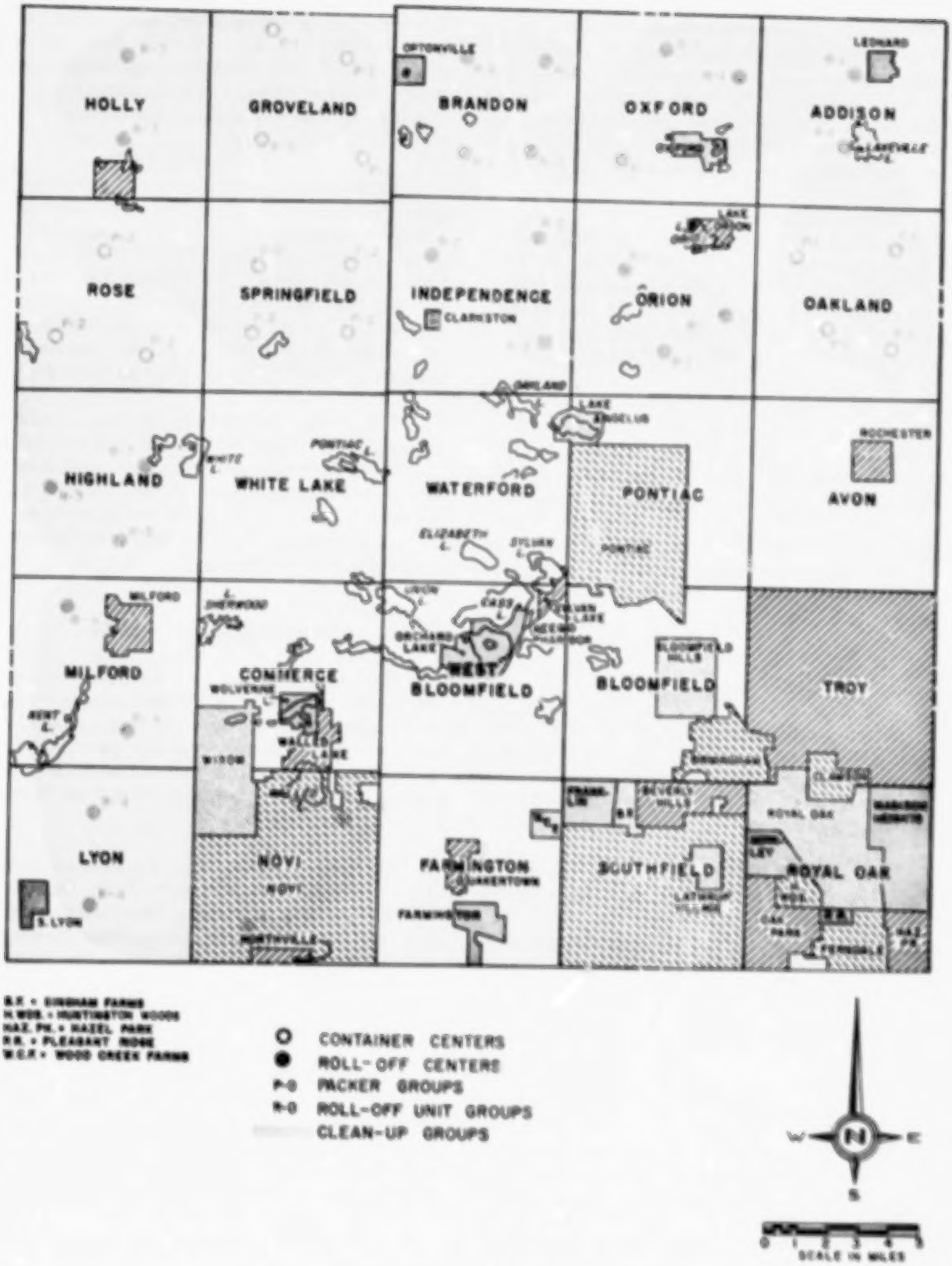
The cost estimates in the preceding paragraph are based on the assumption that all sites have adequate cover material and suitable terrain for the purpose. If insufficient cover material is available or if the soil conditions are poor, the cost of creating landfills may be much greater than our estimates.

Closing Existing Disposal Sites

The change from a casual form of refuse disposal to a thoroughly planned one will require that existing disposal sites be properly closed. The cost of closing active disposal sites will vary according to the conditions at each site. Old partially-closed disposal sites should be brought to acceptable standards.

We have estimated that the cost of closing these disposal sites will vary from $6,000 to $12,000 per acre, depending upon the geography and conditions of the site. These estimates include the cost of vermin extermination, grading the site, applying final cover and seeding the area. We have assumed adequate material for cover exists on all sites. If not, existing cover material can be supplemented with imported cover. In the latter case the cost of supplying dirt will need to be added to the figures indicated above. The cost of closing all existing disposal sites not operated as sanitary landfills and of all improperly closed sites will be in excess of $2,400,000, assuming an average cost of $10,000 per acre for this purpose.

The total cost of proper covering and closure


HOLLY
GROVELAND
ORTONVILLE
BRANDON
OXFORD
LEONARD
ADDISON
ROSE
SPRINGFIELD
INDEPENDENCE
CLARKSTON
ORION
LAKE ORION
OAKLAND
HIGHLAND
WHITE LAKE
WHITE L.
PONTIAC L.
WATERFORD
LAKE ANGELUS
PONTIAC
ROCHESTER
AVON
ELIZABETH L.
SYLVAN L.
MILFORD
SHERWOOD
UNION L.
CASS L.
ORCHARD LAKE
KEEGO HARBOR
COMMERCE
WOLVERINE L.
WEST BLOOMFIELD
BLOOMFIELD
BLOOMFIELD HILLS
TROY
KENT L.
WIXOM
WALLED LAKE
BIRMINGHAM
CLAWSON
LYON
S. LYON
NOVI
NORTHVILLE
FARMINGTON
QUAKERTOWN
FRANKLIN
B.F.
BEVERLY HILLS
SOUTHFIELD
LATHRUP VILLAGE
ROYAL OAK
MADISON HEIGHTS
BERKLEY
H. WDS.
OAK PARK
P.R.
FERNDALE
HAZ. PK.
B.F. = BINGHAM FARMS
H.WDS. = HUNTINGTON WOODS
HAZ. PK. = HAZEL PARK
P.R. = PLEASANT RIDGE
W.C.F. = WOOD CREEK FARMS
○ CONTAINER CENTERS
● ROLL-OFF CENTERS
P-0 PACKER GROUPS
R-0 ROLL-OFF UNIT GROUPS
CLEAN-UP GROUPS
W
N
E
S
0
1
2
3
4
5
SCALE IN MILES

CONVENIENCE CENTER GROUPS

1980-1990

FIGURE 14

of existing sites will not be paid by the County. Most of the active disposal sites are privately owned and under permit from the Health Department. The owners of these sites will properly close them when operations cease according to their permits. This will mean that about 190 acres of site closure will be done privately. An estimated fifty acres of abandoned solid waste disposal sites which are improperly closed will remain for the County to close. Since closure may be done with clean fill dirt or other material using the partially closed dump as a disposal site, this $500,000 cost has not been included in previous cost tables.

Rat extermination is mentioned in the preceding paragraphs. This item must not be forgotten when existing sites are closed because burial will not eliminate the rat population. The rats will burrow out from the buried refuse and migrate to nearby homes or farms in search of a food supply. Extermination is the surest method of stopping these migrations after a site is closed. The cost of rat extermination is negligible, probably between $50 and $100 per acre. The value of such a program is immeasurable.

Recommendation for the Rural Problem

We believe that convenience centers located within four road miles of any point in the Township will be more acceptable to the nearby residents than sanitary landfills, and that convenience centers will help pay for themselves through such intangible assets as resident convenience and a more attractive appearance. Collections from the convenience centers should be incinerated or otherwise disposed of by the County Agency.

Convenience centers located at such frequent intervals throughout the rural areas will help keep Oakland County clean and attractive. Convenience centers will gain the confidence of the general population that refuse disposal is not an ugly business and that it can be conducted in an aesthetic and attractive manner. A greater savings than the difference in average annual operating costs between sanitary landfills and convenience centers will probably be realized by savings in roadside cleanup because the public is more likely to use convenience centers than landfills, particularly if the landfill operation is not perfect at all times.

We recommend that all improperly closed disposal sites within the County be closed under the direction of the County Agency. This will include all sites listed in the Appendix. Closure should include vermin control where the need is apparent or in question.

PLAN PRESENTATION AND IMPLEMENTATION

PROPOSED SOLUTIONS

In this section of the Report we set forth the proposed solution to the refuse disposal problem of Oakland County. This solution is necessarily divided into two plans, each dependent upon an action of the Southeastern Oakland County Incinerator Authority. Both plans are discussed in detail together with a contingent course of action should the City of Pontiac decline to participate. Facilities which will be required under each plan and the costs each will incur are included in the discussion.

The two plans for a solution to the problem are called for convenience Plan A and Plan B. Plan A envisions a program for all the County including provision for incinerating the production of SEOCIA in excess of their nominal burning capacity. Plan B is more limited in scope and makes the assumption that SEOCIA will remain an independent Authority devoted to adequate disposal of all waste created by its members. The final choice of the plan to implement will depend upon decisions by the Oakland County Board of Supervisors and the SEOCIA Board of Directors.

The SEOCIA is a totally independent refuse disposal operation at this time. The Authority is finding its facilities overloaded by the refuse generated by its members and must dispose of part of its waste without incineration at the sanitary landfill in Avon Township. The Board of Directors of the Authority will need to make a decision whether they will cooperate with a county-wide program or whether they prefer to continue on an independent course. The Board of Supervisors of Oakland County for their part must decide whether to offer County facilities for Authority use. It is for these reasons that plans are presented including the Authority and without its participation.

The City of Pontiac is now developing a two hundred acre site for a Municipal Sanitary landfill. The proposed site will be adequate for Pontiac's use for more than 25 years according to projected loads. The site is well isolated and the landfill will probably not be an objectionable operation. For these reasons it is conceivable that Pontiac will elect to continue operating their facility and remain independent of the County program.

Both Plan A and Plan B require the full cooperation of all governmental units within Oakland County. Refuse disposal programs under each Plan incorporate the transportation of refuse from one political unit to another. Final disposal of refuse will in most instances take place in a third political jurisdiction. The quantities predicted for transportation and incineration in both Plans assume that all political jurisdictions in Oakland County will cooperate. Failure to achieve complete cooperation of the political entities within the County will create a condition wherein facilities are oversize, in some cases to the point of being inefficient to operate. The cooperation of governments within the County may demand that some individual interest must be subordinated for the welfare of the entire community.

The projected growth of Oakland County is varied. Rural areas are expected to grow much more rapidly than semi-rural areas, and the heavily developed areas are expected to remain nearly static in population. Despite this varying growth rate, the population will increase too greatly to permit initial equipment installation to meet 1990 needs. The design period has therefor been divided into decades for discussion purposes. The first time period consists of the decade from 1970 - 1980; the second, the decade from 1980 - 1990.

Facility Location

The number and size of incinerators and transfer stations were determined from evaluations of alternative plans. The use of a large number of incinerator sites using small furnace sizes reduces transportation costs. However, a comparison of annual cost for the County disposal program during the preliminary study indicated an advantage to few incinerator sites using large furnaces, with transfer stations to reduce haul problems.

The preliminary studies did not consider

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savings due to reduced collection costs. Collection from most of the areas of Oakland County is now done by private haulers, who take their collections to private disposal sites which may be up to 20 miles away. Frequently the hauler passes a site operated by another on his way from the collection route to his own disposal area. Under the plans proposed in this section of the Report, a publicly operated disposal site, transfer station or large convenience center will be located about 10 miles from any point in the County. Haulers will probably use the facility closest to the end of their daily route, so a savings in collection cost should result.

Capacities of incinerator facilities mentioned in the text refer to tons per 24 hour day. Some transfer stations indicated in the Figures are shown in more than one color as are their respective service areas. This is done to indicate by corresponding colors the incinerator used by that transfer station.

Incinerators and transfer stations have been located as near as possible to the load center of their service area. Usually the best combination of land use, access, and other facilities could be found within 3 miles of the load center. The maximum variation of about 5 miles occurs with the Avon Incinerator under Plan B, but the selected location permits reasonable travel times from its entire service area.

Several sites were chosen and evaluated before those presented under the Plans were selected. Selection was based on several factors including availability of utilities, land area, surrounding land use, soil borings, topographic features, zoning, and a site inspection from both the ground and the air. Incinerators should be constructed on parcels of 10 acres minimum size, preferably on 20 or more acres of land. Transfer stations should occupy sites 5 acres minimum and preferably 10 acre sites. Convenience centers can use sites of 1 acre or less.

We believe the chosen sites are the best available from an engineering standpoint. Some of the sites not chosen were nearly equal to the selected sites. The final decision on the sites considered the probable public acceptance of them for refuse disposal purposes.

Convenience centers are proposed according to the plan discussed earlier. Convenience centers are to be placed in the fourteen rural townships to replace the township dumps and private disposal facilities.

There are several private haulers operating in Oakland County at the present time. The solution to the problem for solid waste disposal will in no way alter their current mode of operation. These haulers are expected to use all facilities proposed in this Report except for convenience centers which are for the use of local citizens as a replacement to the township dump. The hauler will continue to collect refuse from individual homes and dispose of it for the individual.

If the private hauler is operating his own solid waste disposal facility, he will be able to continue to use it provided he meets the requirements established under Public Act 87. Failure of the private hauler to comply with these regulations will bring notice from the Health Department to improve his operation or to close his facility. In the event he must close his facility, the County operation will be available for his use. However, we believe it necessary to point out that it will be the duty of the State Department of Health and the local Health Department to rigidly enforce their requirements for good solid waste disposal. The continuation of even a mediocre sanitary landfill at the same time the County operates an incinerator program will undoubtedly cause much refuse to go to the landfill. Strict adherence must be made to requirements.

The plans proposed for a solution to the solid waste problems of Oakland County, presupposed that all government units in each service area will join the program. We have assumed that all refuse will be brought to a County facility and that none, except for special industrial waste, will be delivered to private disposal operators. Failure to attain full cooperation of all governments within the service area, or to require the improvement of the many private disposal sites to acceptable standards, will result in a reduction of refuse volume to the installations proposed. Any reduction in volume arriving at these sites will reduce the size of units and cause the unit cost of disposal to increase.

Cost Estimating

A necessary part of comparing two or more plans is estimating costs. Throughout the following pages numerous references are made to cost and pricing figures. In order to help the reader understand these figures, a brief discussion of the pricing and cost comparing methods is essential.

Basic costs were obtained from manufacturers. In most instances, more than one manufacturer of an item was asked to offer estimating prices for his equipment. Labor costs are estimated from wage rates supplied by the Michigan Industrial Relations Department and from current industry practice. The cost of equipment and labor used for estimates in this Report is high enough to cover the best equipment of its type currently available.

Installation costs were obtained from contractors or from equipment manufacturers' figures on installation contracts for their equipment.

Operating and maintenance costs for vehicles, incinerator plants, transfer stations and other items of equipment are based on figures supplied by owners of similar equipment.

All costs used for estimating are escalated to the years 1970, 1980 and 1990. 1970 base figures were estimated for structures and specialized refuse handling equipment from actual or currently estimated costs. These figures were projected by using the Engineering News Record construction cost index as a guide. Vehicle costs, salaries and operating and maintenance costs are assumed to increase at the 3-1/2% current rate of the cost of living index. Replacement for equipment of short life is assumed to be provided for by a sinking fund invested at 4% interest.

Estimates of construction are increased by 20% to allow for engineering and contingencies. No allowance is made for the cost of selling bonds nor of obtaining contracts from participating communities.

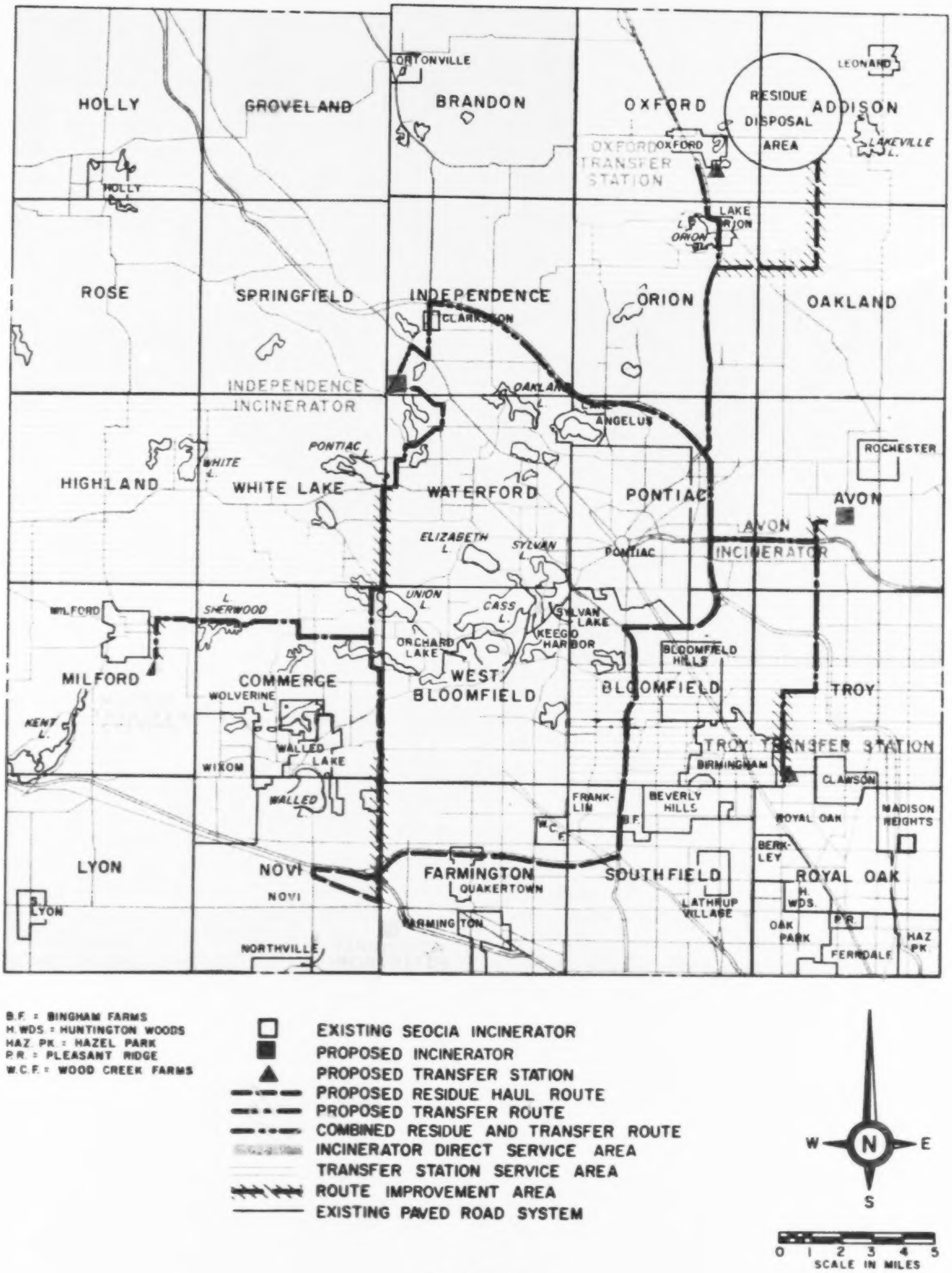
We estimate the current bond market for Oakland County is 5% per annum. Bonds sold in 1980 or after are assumed to carry a 6% interest rate.

Land costs used in making the estimates presented in the Report are derived from information obtained from real estate advertisements and real estate agents in Oakland County. A wide variance in the cost of commercial and industrial land occurs throughout the County. Land prices of under $1,000 an acre were encountered as well as land prices in excess of $30,000 an acre. We have used locally appropriate land cost in this Report.

All capital costs were reduced to bonded annual cost for comparative study of the plans presented. The annual cost figures include interest and principal payments only, with no provision for bond coverage. Operation, maintenance, labor, sinking fund, and other annual cost figures were added to the annual cost of bonding the capital investment to obtain the annual cost figures used throughout the Report.

Certain costs are indicated for road construction purposes under items for residue disposal and secondary transportation. The cost figure presented under each of these items does not represent the complete cost of road rebuilding and construction. For purposes of this study, we have assumed that the road surfacing will be paid for under the Incinerator Program. Since the road improvement program will benefit others beyond those abutting the highway and the refuse agency for the County, we have assumed that the Road Commission will pay for the grading and straightening required to improve these highways. The cost of culverts, utility relocation and other incidental costs are also left to the Road Commission or to the agencies who have present responsibility for these items.

Estimates of cost include a section for administration. The costs included under this item contain one half of the salary of the Drain Commissioner plus an adequate staff, supplies and vehicles. The solid waste program will require additional space beyond that available at the present offices for administration and for vehicular maintenance. We have made an allotment in the estimate to construct a new maintenance and office building for use of the solid waste agency. Additional office space can be provided in the building and rented by the solid


HOLLY
GROVELAND
ORTONVILLE
BRANDON
OXFORD
RESIDUE DISPOSAL AREA
LEONARD
ADDISON
OXFORD
LAKEVILLE L.
OXFORD TRANSFER STATION
HOLLY
LAKE ORION
ORION L.
ROSE
SPRINGFIELD
INDEPENDENCE
CLARKSTON
ORION
OAKLAND
INDEPENDENCE INCINERATOR
OAKLAND
LAKE ANGELUS
ROCHESTER
HIGHLAND
WHITE L.
PONTIAC L.
WHITE LAKE
WATERFORD
PONTIAC
AVON
AVON INCINERATOR
ELIZABETH L.
SYLVAN L.
PONTIAC
WILFORD
L. SHERWOOD
UNION L.
CASS L.
SYLVAN LAKE
KEEGO HARBOR
ORCHARD LAKE
BLOOMFIELD HILLS
MILFORD
COMMERCE
WOLVERINE L.
WEST BLOOMFIELD
BLOOMFIELD
TROY
KENT L.
WALLED LAKE
WIXOM
TROY TRANSFER STATION
BIRMINGHAM
CLAWSON
WALLED L.
FRANKLIN
BEVERLY HILLS
B.F.
W.C.F.
ROYAL OAK
MADISON HEIGHTS
BERKLEY
LYON
NOVI
FARMINGTON
SOUTHFIELD
ROYAL OAK
QUAKERTOWN
NOVI
H. WDS.
LATHRUP VILLAGE
S. LYON
FARMINGTON
OAK PARK
P.R.
HAZ PK.
NORTHVILLE
FERNDALE
B.F. = BINGHAM FARMS
H.WDS. = HUNTINGTON WOODS
HAZ. PK. = HAZEL PARK
P.R. = PLEASANT RIDGE
W.C.F. = WOOD CREEK FARMS
☐ EXISTING SEOCIA INCINERATOR
■ PROPOSED INCINERATOR
▲ PROPOSED TRANSFER STATION
PROPOSED RESIDUE HAUL ROUTE
PROPOSED TRANSFER ROUTE
COMBINED RESIDUE AND TRANSFER ROUTE
INCINERATOR DIRECT SERVICE AREA
TRANSFER STATION SERVICE AREA
ROUTE IMPROVEMENT AREA
EXISTING PAVED ROAD SYSTEM
N
W
E
S
0 1 2 3 4 5
SCALE IN MILES

PLAN A
1970-1980 DECADE

FIGURE 15

waste administration. The entire cost of the building has been charged to the solid waste program. If another county agency shares space in this building, then it should pay a fair rent to the solid waste program or share in the capital and maintenance costs of the building. We anticipate that a suitable site for construction can be found on the grounds of one of the proposed incinerators or near the County Civic Center.

Vehicular equipment listed as necessary at the various facilities is the minimum requirement. No standby or spare equipment appears in these listings. Cost estimates do include spare equipment by providing for one additional tractor unit for every five required, and a spare for every ten trailers. The residue disposal area can operate with any one piece of equipment out of service although the operation would be much more efficient if all major pieces were functional. We do not believe that the added efficiency warrants standby equipment for the residue disposal area. If a breakdown restricts operations too greatly, rental equipment is readily available to use until the County's equipment can be restored to operation.

PLAN A

Plan A encompasses all of Oakland County including excess refuse from SEOCIA. Under this plan, all refuse of combustible nature will be delivered to incinerators scattered throughout the County. Delivery of refuse to the incinerators will be facilitated through secondary transport systems. Rural areas will be aided in refuse handling by convenience centers designed to supplement whatever rural refuse collection or disposal is provided by the individuals themselves.

In preparing Plan A, that including cooperation with the Authority, we have made some assumptions. We have assumed the Authority will want to remain as independent as possible of a complete County program. This independence will lead the Authority to continue operating the Madison Heights incinerator and the Avon residue disposal area. In this manner the Authority can continue to regulate its incinerator and landfill under the control of the participating members. Cooperation with the County will merely be a means of reducing the volume of refuse which must be handled by the Authority's disposal facilities. Cooperation with the County would relieve the overloaded conditions existing at the present incinerator.

Under the cooperative plan the County would construct and maintain all facilities outside of the Authority. In return, the County would sell its capacity at a specified rate per ton and would complete the disposal of refuse brought to it by Authority members. The Authority could reduce the charges by the County by permitting it to use the Avon ash disposal facility. A joint operation between the County and the Authority should bring a benefit to both parties.

Figure No. 15 shows conditions under Plan A for the first decade.

Incinerators

Three incinerators are shown on the Plate for construction in the 1970-1980 decade. These three incinerators are the Avon incinerator located in central Avon Township, the Farmington incinerator located in western Farmington Township and the Independence incinerator located in southwestern Independence Township. In addition to these three, the existing incinerator operated by the SEOCIA is shown in Madison Heights. The location of these units is approximate and no specific parcel of land has been chosen for their construction site. In the following paragraphs we will discuss the general aspects of each incinerator proposed.

Avon Incinerator

The Avon Incinerator is located centrally in Avon Township. It is on an industrially zoned parcel of ground isolated from present subdivisions by approximately a mile on the northeast and east. Subdivisions are approximately a half mile to the northwest and south.

The capacity required by the Avon Incinerator is 1300 tons per day. This capacity will be made up by 4 furnaces, each with a rated daily capacity of 325 tons, all of which is to be installed in the 1970 - 1980 construction period.

The site on which the Avon Incinerator is situated lies within two miles of an interchange on M-59 which provides easy connection to I-75 and US-24. The Grand Trunk Railroad abuts the proposed incinerator site.

Public sewer service is reasonably available to the site. A sewer constructed by the County Department of Public Works is located in Avon Road. This sewer is served by a small sewage treatment plant along the Clinton River southeast of the city of Rochester. The size of sewers and plant prevent the use of these sewers for process water from the incinerator. However, we believe this sewer system is available for sanitary waste from the plant.

Process water will have to be treated on the site. Restrictions on discharging wastes to the rivers of the state are strict enough to make the cost of treatment for discharge little different from treatment for reuse. Hence, most of the process water will probably be recycled through the system. Sludges and other residue from treatment will be disposed of at the residue area if they cannot be burned in the incinerator. An alternative to thorough treatment of process water is discharging it to the proposed Clinton-Oakland trunk sewer system leading to Detroit. This trunk sewer is in the Paint Creek and Clinton River valleys in Rochester, a distance of 2-1/2 miles away along the river valley.

The public water supply from the City of Rochester is available approximately 1-1/2 miles from the proposed site. The Rochester water system is served by wells and an elevated storage tank. It may not be capable of supplying all needs of the incinerator plant. If public water supply is insufficient for the incinerator a private well supply for plant water can supplement the potable water available from the City system.

The residue produced by the Avon plant will require 3 trailers and 1 tractor to remove it from the site for disposal.

Farmington Incinerator

The Farmington Incinerator is proposed in western Farmington Township on land zoned for industrial use at this time. Land prices in this area are extremely high, so that it may be desirable to move the location to presently undeveloped residential land within a reasonable distance. Any movement of the proposed incinerator site should be carefully planned to avoid the location of proposed Highway I-275. The site chosen is on the fringes of the expanding suburbanized area of Detroit, but at this time is isolated approximately one mile from any extensive residential or commercial subdivision. Noise and traffic problems are somewhat reduced by this location due to the relationship of the site to Highway I-96 and the Farmington Industrial Park.

The Farmington Incinerator should be constructed for an ultimate capacity of 1,600 tons of refuse per day. This capacity should be spread among four furnaces of 400 ton per day capacity each. Three of these furnaces with capacity of 1,200 tons per day will be required with the initial construction to provide the intended service at this site.

Material arriving at or leaving the Farmington Incinerator site has excellent highway service. Existing Interstate Highway access is within two miles of the intended site. The Interstate Highways 96 and 696 provide interchanges with several north-south highways in Oakland County, including easily reached US Route 24. The proposed construction of Highway I-275 through Farmington with a connection of I-75 in Springfield Township will provide rapid north-south highway transportation from the proposed site.

Access to the C & O Railroad is approximately 3-1/2 miles from the location proposed for the Farmington Incinerator. In the event that rail transportation of residue or refuse is utilized in the future, a transfer station for this purpose can be located on this railroad, or a spur line constructed to the site. The spur could bring rail service into the industrial park, thereby benefitting the industrial development of the area.

The site proposed for the Farmington Incinerator is serviced by public water and sewer facilities. These utilities do not reach into the proposed site at this time but are sufficiently close so that no problem is foreseen in their use.

The Farmington Incinerator should be supplied with three 40 yard residue trailers and two tractor units.

Independence Incinerator

The Independence Incinerator is located in the southwest corner of Independence Township on land currently zoned for industrial use. The selected site is isolated from present subdivisions by approximately a mile on the north and east. Further encroachment of subdivision development is restricted because of a lake and swampy land in the immediate vicinity. Land to the south and west of the selected site is virtually vacant.

The capacity which should be installed in the Independence Incinerator is 1500 tons per day. The installation should include four 375 tons per day incinerator units, all of which are to be installed in 1970.

The Independence Incinerator site is located approximately 2 miles from US Route 10 and 3-1/2 miles to an interchange on Route I-75. Route I-75 provides connections with Michigan State Route 15 and US Route 24 so that easy access to the Independence site is available to highway transportation.

The Grand Trunk Railroad has a single track adjacent to the proposed site.

The site selected for the Independence Incinerator is without water or sewer service. If the construction takes place immediately, the water supply must be from wells and sewage treatment must be done by private facilities on the plant ground. The Oakland County Department of Public Works is planning to begin construction later this year on the Clinton-Oakland sewer system serving much of Waterford Township. When this sewer system is operative, a 24 inch trunk sewer will reach within approximately a mile and a half of the proposed incinerator site.

The Independence Incinerator site should be equipped with four 40 cubic yard residue trailers and two tractors at the time of its initial installation.

Secondary Transportation

Secondary transportation is needed under Plan A to increase the efficiency of hauling from outlying areas to the incinerators.

Travel times from the western, southeastern and northeastern portions of the County were too long to permit route vehicles to be effective for haul to the incinerator. Travel times were clocked by study personnel over proposed alternative haul routes and the shortest route in terms of time used in the study recommendations. Haul times in excess of one-half hour from proposed transfer station to the incinerator occurred for all except the northwestern quadrant of the County, where I-75 provides swift direct haul.

Transfer stations will be located in Milford Township, Oxford Township and in the City of Troy. The station locations are shown in a general way by triangles on the Plate.

Milford Transfer Station

The Milford transfer station will be located in the northeastern portion of Milford Township. The area in which the station is proposed is zoned for agricultural use. The area is relatively isolated with but a few scattered dwellings in the immediate area of the proposed station.

The transfer station for Milford would be capable of loading four trailer units at one time. The station would remain open 16 hours a day for use by the citizenry and transportation vehicles would operate on the highways only during a 16 hour period.

The refuse brought to the Milford Station would be transported by highway to either the Independence Incinerator or the Farmington

Incinerator. Half the loads will go to the Farmington Incinerator and will be routed over Commerce Road and Haggerty Highway. The remaining loads will be delivered to the Independence Incinerator by way of Commerce Road, Union Lake Road, Cooley Lake Road, Williams Lake Road, Airport Road and Andersonville Road. Rail transportation is available approximately 1/4 mile from this transfer site.

Public water and sewer facilities are available to the site through the village of Milford system. A small pumping station and force main will be required in order to service the proposed station with sewers.

The vehicular equipment required to service the Milford transfer station will include 4 tractors and 17 refuse trailers. This equipment will be able to supply the needs of the station over a 16 hour period.

Oxford Transfer Station

The Oxford transfer station is situated in southeastern Oxford Township. It is located on land currently zoned for industrial use and is well isolated from existing or potential dwellings. The four unit Oxford transfer station will route refuse to the Avon incinerator during the 1970 - 1980 decade. The route for delivering this refuse will be US Route 24 and M-59 to Crooks Road exit. The Oxford Station can be serviced by the Grand Trunk Railroad which has a spur track adjacent to the proposed site.

Utility service for the Oxford Transfer Station will be a combination of private and public supply. Water can be supplied from the Oxford Village system which has a water main within one mile of the proposed site. No sewer service is available however and a private disposal facility must be included at this location.

The equipment necessary to service the Oxford Transfer Station will be 3 tractor units and 8 transfer trailers during the first decade of operation.

Troy Transfer Station

We propose that the Troy Transfer Station occupy the ground on Coolidge Road now being considered for a transfer station site by SEOCIA. The land at this site is zoned for industrial use and there is little isolation from surrounding development. A railroad on the west side of the property will separate the transfer station site from residential development. The rest of the area in the vicinity of the proposed station is industrially developed

We propose that the Troy Transfer Station be large enough to accommodate 6 transfer trailers at one time. The transfer routes from the Troy Transfer Station would be via Maple and Crooks Roads to the Avon incinerator site. We have mentioned that the Grand Trunk Railroad abuts the property considered for this station site.

All public utilities are available for this transfer station.

We recommend that the site purchased be a minimum of 12 acres in size. The transfer station will become obsolete at the end of the first decade since increasing refuse production in its service area will be able to support an incinerator. Future incinerator construction will require the additional land.

The vehicular equipment needed to service the Troy Transfer Station consists of 6 tractor units and 16 trailers. This total includes standby equipment necessary for this station to operate 24 hours a day.

Residue Disposal

Residue generated by the incinerator plants under Plan A will be taken to the ash disposal site in Addison Township. The site is situated in the western portion of Addison Township and consists of land not presently used for agricultural purposes. The land can be reached by the Grand Trunk Railroad or by highways. In order to utilize road transportation of residue, approximately 3 miles of highways must be brought to the Class A standard of the Oakland County Road Commission.

The disposal site should have capacity for approximately 5500 acre feet of residue over the 20 year life of this project. The 5500 acre feet will include approximately 20% cover material, and about 15% will be devoted to bulk refuse and hazardous refuse disposal. The capacity of the site is based on the assumption that 50% compaction of residue can be achieved in the landfill. A large parcel of land will be required for the residue disposal area. To achieve the 5500 acre foot capacity in a single site will require approximately 275 acres of land if fill depths reach 20 feet. If this parcel of land is square and a 500 foot isolation distance is maintained between the edges of the property and the actual fill, 460 acres of land will be required. Fill depths up to 80 feet are possible in certain areas in the vicinity selected for residue disposal. The effect of greater depth is to reduce the area of land required for residue disposal. There are several parcels of land suitable for residue disposal in western Addison Township from which the final choice may be selected.

Heavy equipment will be required to operate the residue disposal fill. We believe that 1 bulldozer with a 250 ton per shift capacity and a front loader with approximately the same capacity will be required to operate the landfill on a 24 hour a day basis. A self-loading scraper pan for moving dirt from remote areas and digging trenches should be provided. This piece of equipment can also be used to cover the residue after it has been compacted. A large building with about 3600 square feet of space should be provided at the site to store the vehicles on weekends and provide space for minor repair and maintenance. This building will consist of a light metal structure with a foundation and an earthen floor in the areas in which the vehicles will operate. This building can house a small office, or a portable trailer unit could be provided for this purpose. Water and sanitary facilities must be provided.

Plan A – 1980-1990

Construction of facilities in the decade 1980-1990 will complete the incinerator program for Oakland County. These are shown on Figure No. 16. At this time the Farmington incinerator will add its fourth 400 ton per day furnace to bring its capacity to 1600 tons per day. The Troy incinerator will be built on the site of the Troy transfer station. This incinerator will provide for 4 - 500 ton per day furnaces, of which 3 will be installed at the beginning of the period. A fourth furnace, which will bring the total rated capacity to 2,000 tons per day, will be needed at the end of the design period.

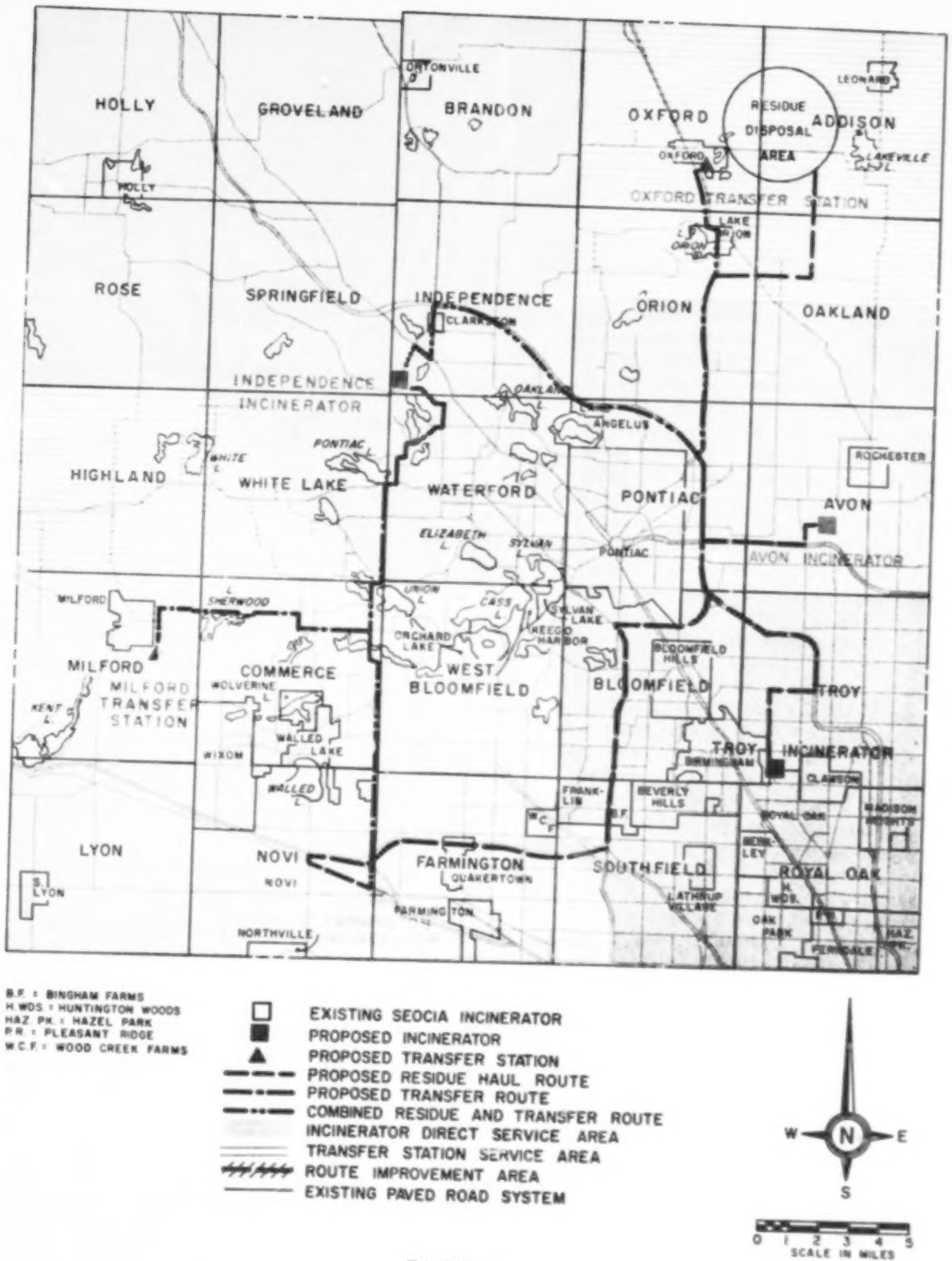
The secondary transport system will be revised. The Troy transfer station will be eliminated and no additional transfer stations are anticipated. The Milford site will continue to split its load between the Waterford and Farmington incinerators. The Oxford transfer station will begin transferring refuse to the Independence incinerator in the second decade of operation. This will relieve the Avon incinerator to preserve capacity for the rapid development anticipated in its service area. The service area of the Troy incinerator will be the northern portion of SEOCIA and much of Bloomfield Township. No added highway construction is anticipated because of the additions to the refuse disposal plant occurring in the 1980-1990 period.

The following table presents a summary of the furnace sizes and transfer station equipment needed at each site for the periods 1970-1980 and 1980-1990. The information contained in this summary is used to estimate the cost of the proposed project.

ESTIMATED EQUIPMENT REQUIREMENTS
PLAN A

INCINERATORS	Installed Capacity T/D *	Ash Truck Tractors	Ash Truck Trailers
Avon			
1970-1980	1300	1	3
1980-1990	1625	1	5
Farmington			
1970-1980	1200	2	3
1980-1990	1600	3	5
Independence			
1970-1980	1500	2	4
1980-1990	1500	2	5
Troy			
1980-1990	1500	4	7

* 6 - 24 hour workdays per week


HOLLY
GROVELAND
ORTONVILLE
BRANDON
OXFORD
RESIDUE DISPOSAL AREA
ADDISON
LEONARD
LAKEVILLE L.
OXFORD
OXFORD TRANSFER STATION
HOLLY
LAKE ORION
ORION
ROSE
SPRINGFIELD
INDEPENDENCE
CLARKSTON
ORION
OAKLAND
INDEPENDENCE INCINERATOR
OAKLAND L.
ANGELUS
ROCHESTER
HIGHLAND
WHITE L.
PONTIAC L.
WHITE LAKE
WATERFORD
PONTIAC
AVON
ELIZABETH L.
SYLVAN L.
PONTIAC
AVON INCINERATOR
MILFORD
SHERWOOD L.
UNION L.
CASS L.
SYLVAN LAKE
KEEGO HARBOR
ORCHARD LAKE
BLOOMFIELD HILLS
MILFORD
COMMERCE
WEST BLOOMFIELD
BLOOMFIELD
TROY
MILFORD TRANSFER STATION
WOLVERINE L.
KENT L.
WALLED LAKE
TROY INCINERATOR
BIRMINGHAM
WIXOM
WALLED L.
FRANKLIN
BEVERLY HILLS
CLAWSON
W.C.F.
B.F.
ROYAL OAK
MADISON HEIGHTS
LYON
NOVI
FARMINGTON
QUAKERTOWN
SOUTHFIELD
BERKLEY
ROYAL OAK
S. LYON
NOVI
LATHRUP VILLAGE
H. WDS.
FARMINGTON
OAK PARK
P.R.
NORTHVILLE
FERNDALE
HAZ. PK.
B.F. = BINGHAM FARMS
H. WDS. = HUNTINGTON WOODS
HAZ. PK. = HAZEL PARK
P.R. = PLEASANT RIDGE
W.C.F. = WOOD CREEK FARMS
EXISTING SEOCIA INCINERATOR
PROPOSED INCINERATOR
PROPOSED TRANSFER STATION
PROPOSED RESIDUE HAUL ROUTE
PROPOSED TRANSFER ROUTE
COMBINED RESIDUE AND TRANSFER ROUTE
INCINERATOR DIRECT SERVICE AREA
TRANSFER STATION SERVICE AREA
ROUTE IMPROVEMENT AREA
EXISTING PAVED ROAD SYSTEM
N
W
E
S
0 1 2 3 4 5
SCALE IN MILES

PLAN A
1980-1990 DECADE

FIGURE 16

TRANSFER STATIONS	Installed Capacity T/D	Transfer Truck Tractors	Transfer Truck Trailers
Milford			
1970-1980	300	4	17
1980-1990		4	23
Oxford			
1970-1980	200	3	8
1980-1990		3	16
Troy			
1970-1980	850	6	16
RESIDUE DISPOSAL SITE	250 T/D Bulldozer	250 T/D Front-Loader	Self-load Pan 10 CY
	1	1	1

Cost of Program

At the present time all factors affecting costs of refuse disposal cannot be known. Previously we pointed out that haul distance for the transfer vehicles, cost of land and the number and location of participating communities will affect the final cost. Therefore, the costs denoted in the following tables and discussion assume total participation of all governmental units in the County, adequate manpower and equipment, and the haul routes indicated on the Plates. Cost figures are thus only an indication of actual costs that may be encountered.

We have prepared a table which is presented on the next page indicating the capital costs and annual cost for each decade of operation until 1990. This Table has been broken down to major items including administration, incinerators, residue disposal, transfer stations and convenience centers. Twenty percent has been allowed for engineering and contingencies on all capital costs for which this would apply. Figures presented for annual cost include amortization, operation and maintenance together with utilities and necessary supplies.

Incinerator costs shown in the table are a summation of all incinerators proposed. The cost of incineration construction and operation is distributed as follows:

Incinerator	Capital Cost		Average Annual Cost	
	1970-1980	1980-1990	1970-1980	1980-1990
Avon	$10,575,500	$ —	$1,672,000	$1,882,200
Farmington	9,882,500	2,242,000	1,792,000	2,242,000
Independence	10,324,500	—	1,913,000	2,204,400
Troy	—	15,076,000	—	3,790,300
Totals	$31,382,500	$17,318,000	$5,377,000	$10,118,900

Transfer station cost estimates shown in the following table apply to each station. The capital cost of land and construction for each station together with annual operating cost is as follows:

Transfer Station	Capital Cost	1970-1980	1980-1990
Transfer Station	Capital Cost	Average Annual Cost	
		1970-1980	1980-1990
Milford	$ 890,700	$ 517,600	$ 692,300
Oxford	501,900	427,000	517,000
Troy	1,850,000	1,031,600	31,700
Totals	$3,242,600	$1,976,200	$1,241,000

The high cost of the Troy station is due to the estimated price of land.

In reviewing the table one will note that the annual average cost of transfer station operation decreases in the 1980-1990 decade. This decrease is brought about by eliminating the Troy transfer station and substituting the Troy incinerator.

The cost of the program can be expressed in terms of cost per ton of refuse delivered. This method of cost accounting provides a ready way to charge customers. The various phases of the program reduced to the cost per ton are listed below based on average tons for each decade. Convenience centers cost is apportioned over the entire County tonnage in this table. An alternative method of financing would permit the individual townships to pay the capital cost of convenience centers within their boundaries and operation only would be distributed County-wide. This method of financing is discussed in more detail under the section entitled "Implementing the Program".

Cost Tabulation $/Ton

Item	1970 - 1980	1980 - 1990
Administration	$ .32	$ .29
Incinerators	5.37	7.13
Incinerators	.76	1.19
Secondary Transportation	1.97	.87
Convenience Centers	1.81	1.59
Total	$10.23	$11.07

The figures listed in the above tabulation indicate the approximate cost of each phase of the refuse disposal program under Plan A. These cost figures do not account for operating or administrative costs of SEOCIA but are indicative of the unit cost per ton for service to all portions of the County including the surplus received from the Authority. These cost estimates are based on

PLAN A COSTS

BUDGET ITEM	1970 Capital * Cost	1970 Annual Cost	1980 Annual Cost	1970-1980 Average Annual Cost	1980 Capital * Cost	1980 Annual Cost	1990 Annual Cost	1980-1990 Average Annual Cost
Administration								
Land	$ 25,000	$ 2,000	$ 2,000	$ 2,000		$ 2,000	$ 2,000	$ 2,000
Buildings	1,050,000	124,200	135,400	129,800		135,400	149,800	142,600
Vehicles	12,600	9,300	12,000	10,600		12,000	15,800	13,900
Payroll		146,300	206,400	176,400		206,400	291,100	248,800
Sub Total	1,087,600	281,800	355,800	318,800		355,800	458,700	407,300
Incinerators								
Land	715,000	57,300	57,300	57,300		57,300	57,300	57,300
Construction Buildings	30,300,000	3,187,500	3,399,600	3,293,600	$17,300,000	6,095,100	6,401,100	6,248,100
Construction Utilities	324,000	26,000	26,000	26,000		26,000	26,000	26,000
Vehicles	43,500	13,200	17,100	15,100	18,000	22,300	29,300	25,800
Payroll		1,646,600	2,323,400	1,985,000		3,120,500	4,403,000	3,761,700
Sub Total	31,382,500	4,930,600	5,823,400	5,377,000	17,318,000	9,321,200	10,916,700	10,118,900
Residue Disposal								
Land	523,000	41,900	41,900	41,900		41,900	41,900	41,900
Construction Building	42,800	14,100	17,100	15,600		17,100	20,900	19,000
Construction Roads	727,400	58,300	58,300	58,300		58,300	58,300	58,300
Construction Utilities	6,000	500	500	500		500	500	500
Vehicles Transportation	199,000	156,300	214,400	185,400	342,000	555,600	765,400	660,500
Payroll Transportation		231,000	326,000	278,500		508,400	717,500	612,900
Vehicles-Land	172,500	54,200	70,800	62,500		79,800	94,400	87,100
Payroll-Land		99,000	139,900	119,500		172,500	243,000	207,800
Sub Total	1,670,700	655,300	868,900	762,200	342,000	1,434,100	1,941,900	1,688,000
Transfer Stations								
Land	376,000	32,800	32,800	32,800		32,800	32,800	32,800
Construction-Building	524,400	63,900	70,000	67,000		58,900	63,600	61,300
Construction-Utilities	122,400	9,800	9,800	9,800		9,800	9,800	9,800
Construction-Roads	319,800	25,600	25,600	25,600		25,600	25,600	25,600
Vehicles	1,900,000	516,800	664,300	590,500		273,000	322,300	297,600
Payroll		1,037,400	1,463,800	1,250,600		675,100	952,600	813,900
Sub Total	3,242,600	1,686,300	2,266,300	1,976,300		1,075,200	1,406,700	1,241,000
Convenience Center								
Land	60,000	4,800	4,800	4,800	8,500	5,500	5,500	5,500
Construction Building	1,201,000	993,200	1,001,600	997,400	112,100	1,014,000	1,025,500	1,019,800
Containers	171,000	62,400	72,000	67,200	130,800	79,900	97,900	88,900
Vehicles	216,400	136,500	184,800	160,700	8,500	203,800	280,200	242,000
Payroll		488,300	689,000	588,700		741,600	1,045,900	893,700
Sub Total	1,648,400	1,685,200	1,952,200	1,818,800	259,900	2,044,800	2,455,000	2,249,900
TOTAL	$39,031,800	$ 9,239,200	$11,266,600	$10,253,100	$17,919,900	$14,231,100	$17,179,000	$15,705,100

* Includes Engineering Fees & Contingencies @ 20% of Capital Cost.

information contained in the text of this Report and in tables in the Appendix.

Omission of Pontiac

Thus far, our discussion has assumed that the City of Pontiac will participate in the county-wide program. The City, with its own successful landfill program may choose to remain independent. Such a choice will have a noticeable impact upon the County program.

If the City operates its own facilities, two of the incinerators proposed under Plan A would be altered to accommodate the reduced load. The Avon Incinerator originally to have a 1300 ton per day capacity would require only about 950 tons per day. We recommend construction to include three 325 ton per day furnaces in 1970. The reduced capacity of the Independence Incinerator would be 750 tons per day installed in 1970, with provision to expand in the second decade by adding one more 375 tons per day furnace. Provision for expansion should be left in the event Pontiac should decide to join a County program.

The remaining construction under Plan A would remain unchanged. However, material from the Oxford Transfer Station would be routed to the Avon Incinerator.

If the City of Pontiac is omitted from Plan A, the capital cost of the program would be reduced by $3,640,000 in the first decade as follows:

	1970 - 1980	
	Plan A	Without Pontiac
Avon	$10,575,500	$9,375,500
Independence	10,924,500	8,484,500

	1980 - 1990	
	Plan A	Without Pontiac
Avon	—	—
Independence	—	$1,710,000

The savings in annual cost will amount to $603,800 as follows:

Amortization of Capital Cost	$280,000
Salaries	186,000
Residue disposal	27,800
Operation & Maintenance of Equipment	100,000

The unit cost per ton resulting from the above savings is higher than if Pontiac were included. This results from a reduction in annual tonnage and is itemized below for the 1970 - 1980 decade:

	Unit Cost/ton
Administration	$ 0.42
Incineration	6.34
Residue Disposal	0.97
Secondary Transportation	2.61
Convenience Centers	2.40
	$12.74

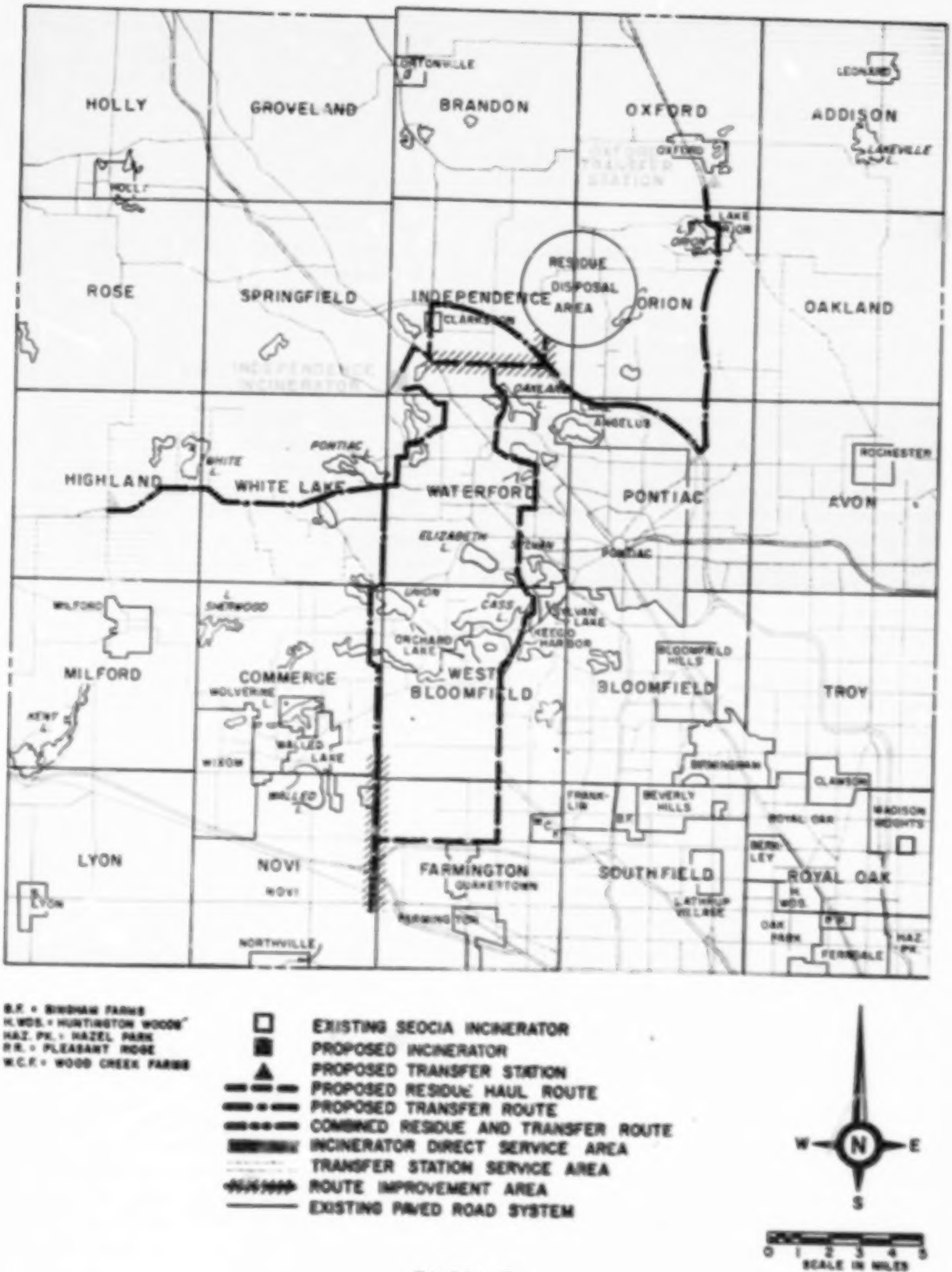
PLAN B

Plan B sets forth a program which will include all members of the Oakland County community who are not members of the SEOCIA. Refuse that originates outside the Authority and can be burned will be delivered to incinerator sites located throughout the County under Plan B. A secondary transport system similar to that proposed under Plan A will be used. Rural areas will be served by a convenience center program.

Figure No. 17 on the page following shows conditions under Plan B for the first decade from 1970 - 1980.

Incinerators

Two incinerators are shown on the Plate for construction in the first decade of operation. These two incinerators are located in Farmington and in Independence Townships. The name designation and location of each of these incinerators is similar to those of Plan A, that is, the Farmington Incinerator and the Independence Incinerator. The locations shown on the Plate for these incinerators are approximate and no specific


HOLLY
GROVELAND
BRANDON
OXFORD
ADDISON
ORTONVILLE
LEONARD
HOLLY
OXFORD
LAKEVILLE L.
OXFORD TRANSFER STATION
LAKE ORION
L. ORION
ROSE
SPRINGFIELD
INDEPENDENCE
RESIDUE DISPOSAL AREA
ORION
OAKLAND
CLARKSTON
INDEPENDENCE INCINERATOR
OAKLAND
ANGELUS
HIGHLAND
WHITE L.
PONTIAC L.
WHITE LAKE
WATERFORD
PONTIAC
ROCHESTER
AVON
ELIZABETH L.
SYLVAN
PONTIAC
MILFORD
SHERWOOD L.
UNION L.
CASS L.
SYLVAN LAKE
KEEGO HARBOR
ORCHARD LAKE
WEST BLOOMFIELD
BLOOMFIELD HILLS
BLOOMFIELD
MILFORD
COMMERCE
WOLVERINE L.
TROY
KENT L.
WIXOM
WALLED LAKE
WALLED L.
BIRMINGHAM
CLAWSON
FRANKLIN
BEVERLY HILLS
B.F.
W.C.F.
ROYAL OAK
MADISON HEIGHTS
LYON
NOVI
FARMINGTON
QUAKERTOWN
SOUTHFIELD
BERKLEY
ROYAL OAK
NOVI
LATHRUP VILLAGE
H. WDS.
S. LYON
FARMINGTON
OAK PARK
P.R.
NORTHVILLE
FERNDALE
HAZ. PK.
B.F. = BINGHAM FARMS
H.WDS. = HUNTINGTON WOODS
HAZ. PK. = HAZEL PARK
P.R. = PLEASANT RIDGE
W.C.F. = WOOD CREEK FARMS
EXISTING SEOCIA INCINERATOR
PROPOSED INCINERATOR
PROPOSED TRANSFER STATION
PROPOSED RESIDUE HAUL ROUTE
PROPOSED TRANSFER ROUTE
COMBINED RESIDUE AND TRANSFER ROUTE
INCINERATOR DIRECT SERVICE AREA
TRANSFER STATION SERVICE AREA
ROUTE IMPROVEMENT AREA
EXISTING PAVED ROAD SYSTEM
N
W
E
S
0 1 2 3 4 5
SCALE IN MILES

PLAN B
1970-1980 DECADE

FIGURE 17

parcel of land has been chosen for a construction site. In the following paragraphs we will discuss the general aspects of each of these two incinerators.

Farmington Incinerator

The Farmington Incinerator has been located in western Farmington Township on land which is industrially zoned. Land prices in this area are very high for land currently selling in the Farmington Industrial Park. If this is an indication of the high cost of land, it may be desirable to move the location of the Farmington Incinerator to a presently undeveloped residential area within reasonable distance of our proposed site. Any movement of the incinerator site must be planned to avoid the location of proposed highway I-275. This highway will be located crossing diagonally across Farmington Township and meeting I-96 near the Novi-Farmington Township line. The proposed site of the Farmington Incinerator is isolated from any extensive residential or commercial development by nearly a mile. Noise and traffic problems created by movement to and from an incinerator site located in this remote area of Farmington Township will be reduced by the relationship of the site to the Highway I-96.

Farmington Incinerator should be constructed for an ultimate capacity of 1,600 tons of refuse daily. This capacity will be provided by 4 furnaces of 400 tons per day capacity each. All four of the proposed furnaces should be installed in the Farmington incinerator site in the 1970 - 1980 decade. Highway service to the Farmington Incinerator site is excellent. The existing Interstate Highway system provides access within 2 miles of the intended site and connections to existing north-south highways in Oakland County through U.S. 24. The proposed Highway I-275 connecting to I-75 in Springfield Township will provide a rapid north-south traffic movement across the western central portion of Oakland County.

Railroad access is approximately 3-1/2 miles from the location of the Farmington Incinerator. In the event rail transportation of refuse or residue is desirable in the future, transfer stations for this purpose can be located on land available adjacent to this railroad, or a railroad spur constructed to the site. Transportation by rail must be a cooperative arrangement between the C & O Railroad and the Grand Trunk Railroad to arrive at the residue disposal site proposed later in this section.

The site proposed for the Farmington Incinerator is presently serviced with public water and sewer facilities. These utilities do not reach into the proposed site at this time but are sufficiently close so that no problem in their use is foreseen.

The Farmington Incinerator should be supplied with one semi-tractor unit and three residue trailers.

Independence Incinerator

The Independence Incinerator is located in the extreme southwestern corner of the Township. The site is isolated from present development by approximately a mile on the northerly and easterly sides. Further encroachment from this direction is restricted because of a lake and swampy land in the immediate vicinity. To the south and west of the selected site the land is virtually vacant.

The capacity of the Independence Incinerator should be for a total of 1,875 tons per day of refuse. The installation should include 4 – 375 ton per day units in the first decade. These will produce a 1,500 ton a day capacity under initial construction. The additional capacity supplied by the fifth furnace can be installed in the second decade.

The Independence Incinerator site is approximately 2 miles southerly from U.S. Route 10 and the distance to the closest interchange on I-75 is about 3-1/2 miles. Route I-75 provides connections with most north-south highways in the County and through U.S. Route 24 provides accessibility to I-96.

The site is served by the Grand Trunk Railroad which abuts the property.

The Independence Incinerator is located on a site without water or sewer service available. If construction takes place in the immediate future, water supply must be from wells and sewage treatment must be done by private facilities. The Oakland County Department of Public Works is currently planning to construct a major trunk sewer system in the Clinton-Oakland project in the near future. This sewer system will provide a 24 inch trunk sanitary sewer near the location of the Independence Incinerator. When this sewer system is operative, connection to it should be made from the incinerator so that public sewer service is provided.

The Independence Incinerator site should be equipped with one residue tractor unit and two 40 cubic yard semi-trailer units.

Secondary Transportation

Refuse originating in areas of the County for which transportation time to the incinerator is excessive will be serviced by transfer stations. Two transfer stations will be located in the County under Plan B, in Highland Township and in Oxford Township. Locations of these transfer stations are shown by Figure No. 17 and are the result of travel time studies made during the course of this investigation.

The Highland Transfer Station

The Highland Transfer Station will be located in the central portion of Highland Township on land that is currently zoned for industrial use. The area in which the transfer station is located contains several scattered residential units. The transfer station has been located as far as possible from the dwellings.

The transfer station at Highland should have four stalls for loading transfer trailers. The station will remain open 16 hours a day for use by local citizenry and transportation vehicles would operate on the highways during the similar 16 hour period.

Refuse brought to the Highland Station will be transported to the Farmington incinerator. Travel will be via Milford Road and I-96 to the Grand River Avenue interchange. Rail transportation is available on the site.

Public water and sewer facilities are not available at the Highland site. Water supply must be by well and sewage facilities will be by private system to serve the site only.

The vehicular equipment required by the Highland transfer station in the first decade will be 2 tractor units and 18 – 80 cubic yard capacity open semi-trailers. This equipment will supply the requirements of the station for 16 hour operation during the first decade.

Oxford Transfer Station

The Oxford Transfer Station is situated southeast of Oxford Village in Oxford Township. The land on which the station is proposed is currently zoned for industrial use and is suitably isolated from potential construction. The Oxford transfer station is proposed large enough for 4 trailer stalls. Material brought to the Oxford transfer station will be routed to the Independence incinerator during the first decade of operation. The route for delivering refuse to this site will be by U.S. Route 24 and I-75.

The Oxford Station can be serviced by the Grand Trunk Railroad, which has a spur track adjacent to the proposed site.

Utility service at the Oxford transfer station will be a combination of private and public supply. Public water supply is available from the water system of Oxford Village. Sewer service must be supplied by private disposal facilities included in the planning for this location.

Residue Disposal

Residue generated by incinerator plants under Plan B would be taken to an ash disposal site along the Independence-Orion Township boundary. Portions of the land considered for this residue disposal site are currently being used for agricultural purposes. Part of the land is presently marsh land. The site can be reached either by railroad or highway. Approximately 2-1/2 miles of County Road must be brought to Class A standard if highway transportation is used. For complete rail transportation approximately 3-1/2 miles of railroad spur must be constructed to the site or supplemental transportation by truck must be provided from an unloading station on the railroad.

The disposal site must have capacity available for approximately 4,300 acre feet of residue over the 20 year life of the project. This volume of material will include 20% cover material and about 15% devoted to bulk refuse and hazardous refuse disposal. The site capacity is based on an assumed 50% compaction of the residue arriving at the landfill. A large parcel of land will be required for residue disposal area. Two hundred twenty acres of land are required to provide sufficient capacity if fill depths of 20 feet are achieved. Assuming a square area with 500 feet of isolation in any direction from the fill area to the edges of the property, a parcel of 380 acres should be purchased.

The heavy equipment required to operate the residue disposal fill will include one bulldozer, one front loader and a pan. We estimate that 250 ton per shift capacity units for loader and bulldozer will be sufficient for operation on a 24 hour a day basis. The self-loading scraper pan for moving dirt and digging trenches should have a capacity from 8 to 10 cubic yards. An equipment storage shed should be provided in which the vehicles can be placed when not in operation or for minor repairs and oil change. This building will be a light prefabricated metal structure with foundation and earthen floors in the areas which the vehicles will operate. This building can also house a small office or a portable trailer unit could be provided near the entrance to the site for office facilities. Equipment can be hauled by low-boy tractor trailer unit to the central maintenance building for major repairs. Water and sewer facilities should be provided.

Plan B – 1980-1990

Construction of facilities in the decade 1980-1990 will complete the incinerator program for Oakland County exclusive of the area served by SEOCIA. The Independence incinerator will add its fifth furnace in this decade, bringing its capacity to 1,875 tons per day. The Avon incinerator will be constructed on the same site proposed under Plan A, 325 ton per day furnaces for a total capacity of 1,625 tons per day. Figure No. 18 indicates Plan B for the second decade.

The Avon Incinerator will be situated on land zoned for industrial use and well isolated from current housing development. The site is approximately two miles from an interchange with M-59, which provides easy access to I-75 and U.S. 24. The Grand Trunk Railroad operates a line abutting the proposed site. Public water and sewer service may be available from the City of Rochester or sewer service may be available from the Clinton-Oakland system. Both systems are about 2-1/2 miles distant from the proposed plant site. Three trailers and 2 tractor units will be needed for residue disposal at the Avon site under Plan B.

The following tabulation summarizes furnace sizes and transportation equipment needed for each site during the periods 1970-1980 and 1980-1990. The information in the summary is used to estimate the costs of the proposed project.

ESTIMATED EQUIPMENT REQUIREMENTS
PLAN B

INCINERATORS	Installed Capacity T/D *	Ash Truck Tractors	Ash Truck Trailers
Avon			
1980-1990	1625	2	3
Farmington			
1970-1980	1600	1	3
1980-1990	1600	1	3
Independence			
1970-1980	1500	1	2
1980-1990	1875	1	2

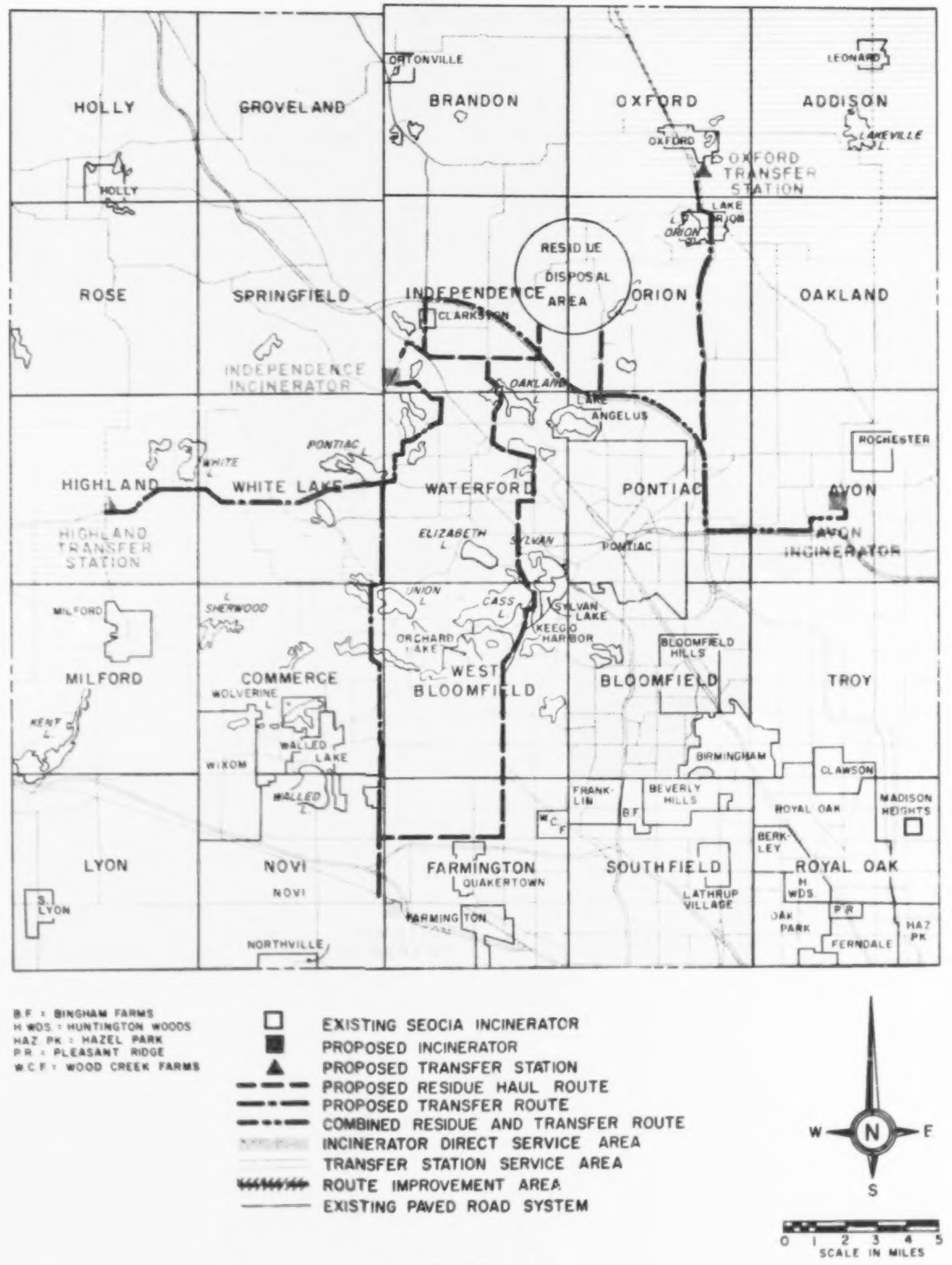
* 6 - 24 hour workdays per week

TRANSFER STATIONS	Installed Capacity T/D	Transfer Truck Tractors	Transfer Truck Trailers
Highland			
1970-1980	450	3	18
1980-1990	450	4	27
Oxford			
1970-1980	250	3	9
1980-1990	250	3	13

RESIDUE DISPOSAL SITE	250 T/D Bulldozer	250 T/D Front-Loader	Self-load Pan 10 CY
	1	1	1

Cost of Program

The costs presented in this section are an indication of the actual costs which may be


HOLLY
GROVELAND
ORTONVILLE
BRANDON
OXFORD
LEONARD
ADDISON
LAKEVILLE L.
OXFORD
OXFORD TRANSFER STATION
HOLLY
LAKE ORION
L. ORION
RESIDUE DISPOSAL AREA
ROSE
SPRINGFIELD
INDEPENDENCE
CLARKSTON
ORION
OAKLAND
INDEPENDENCE INCINERATOR
OAKLAND L.
LAKE ANGELUS
PONTIAC L.
WHITE L.
ROCHESTER
HIGHLAND
WHITE LAKE
WATERFORD
PONTIAC
AVON
HIGHLAND TRANSFER STATION
ELIZABETH L.
SYLVAN
PONTIAC
AVON INCINERATOR
MILFORD
L. SHERWOOD
UNION L.
CASS L.
SYLVAN LAKE
KEEGO HARBOR
ORCHARD LAKE
BLOOMFIELD HILLS
MILFORD
COMMERCE
WEST BLOOMFIELD
BLOOMFIELD
TROY
WOLVERINE L.
KENT L.
WALLED LAKE
WIXOM
BIRMINGHAM
CLAWSON
WALLED L.
FRANKLIN
B.F.
BEVERLY HILLS
W.C.F.
ROYAL OAK
MADISON HEIGHTS
BERKLEY
LYON
NOVI
FARMINGTON
QUAKERTOWN
SOUTHFIELD
ROYAL OAK
NOVI
H WDS.
LATHRUP VILLAGE
S. LYON
FARMINGTON
OAK PARK
P.R.
HAZ PK
NORTHVILLE
FERNDALE
B.F. = BINGHAM FARMS
H WDS. = HUNTINGTON WOODS
HAZ PK = HAZEL PARK
P.R. = PLEASANT RIDGE
W.C.F. = WOOD CREEK FARMS
☐ EXISTING SEOCIA INCINERATOR
■ PROPOSED INCINERATOR
▲ PROPOSED TRANSFER STATION
PROPOSED RESIDUE HAUL ROUTE
PROPOSED TRANSFER ROUTE
COMBINED RESIDUE AND TRANSFER ROUTE
INCINERATOR DIRECT SERVICE AREA
TRANSFER STATION SERVICE AREA
ROUTE IMPROVEMENT AREA
EXISTING PAVED ROAD SYSTEM
N
W
E
S
0 1 2 3 4 5
SCALE IN MILES

PLAN B
1980-1990 DECADE

FIGURE 18

PLAN B COSTS

BUDGET ITEM		1970 Capital * Cost	1970 Annual Cost	1980 Annual Cost	1970-1980 Average Annual Cost	1980 Capital * Cost	1980 Annual Cost	1990 Annual Cost	1980-1990 Average Annual Cost
Administration									
Land		$ 25,000	$ 2,000	$ 2,000	$ 2,000		$ 2,000	$ 2,000	$ 2,000
Buildings		1,050,000	124,200	135,400	129,800		135,400	149,800	142,600
Vehicles		12,600	9,300	12,000	10,600		12,000	15,800	13,700
Payroll			146,300	206,400	176,400		206,400	291,100	248,800
	Sub Total	1,087,600	281,800	355,800	318,800		355,800	458,700	407,100
Incinerators									
Land		475,000	38,100	38,100	38,100		38,100	38,100	38,100
Construction Buildings		24,510,000	2,578,500	2,750,100	2,664,300	$19,290,000	5,112,800	5,523,000	5,317,900
Construction Utilities		30,000	2,400	2,400	2,400	170,400	17,300	17,300	17,300
Vehicles		34,800	9,200	11,800	10,500	21,600	17,800	23,300	20,600
Payroll			1,171,100	1,652,400	1,411,800		2,569,800	3,626,000	3,097,900
	Sub Total	25,049,800	3,799,300	4,454,800	4,127,100	19,482,000	7,755,800	9,227,700	8,491,800
Residue Disposal									
Land		1,650,000	132,300	132,300	132,300		132,300	132,300	132,300
Construction-Building		42,800	14,100	18,500	16,300		18,500	21,000	19,800
Construction-Roads		735,200	59,000	59,000	59,000		59,000	59,000	59,000
Construction-Utilities		6,000	500	500	500		500	500	500
Vehicles-Transportation		103,500	93,700	120,500	104,100	123,000	256,900	354,700	305,800
Payroll-Transportation			80,600	113,900	97,300		231,000	326,000	278,500
Vehicles-Landfill		132,500	41,700	54,600	48,100	64,000	75,200	99,500	87,300
Payroll-Landfill			75,900	107,100	91,500		172,100	243,300	207,700
	Sub Total	2,670,000	497,800	606,400	552,100	187,000	945,500	1,236,300	1,090,900
Transfer Stations									
Land		35,000	2,800	2,800	2,800		2,800	2,800	2,800
Construction-Building		314,400	38,300	42,000	40,200		42,000	48,900	45,500
Construction-Utilities		32,400	2,600	2,600	2,600		2,600	2,600	2,600
Construction-Roads									
Vehicles		617,800	188,200	245,200	216,700	313,600	334,600	435,100	384,800
Payroll			410,200	578,800	494,500		675,000	952,400	813,700
	Sub Total	999,600	642,100	871,400	756,800	313,600	1,057,000	1,441,800	1,249,400
Convenience Center									
Land		60,000	4,800	4,800	4,800	8,500	5,500	5,500	5,500
Construction Building		1,201,000	993,200	1,001,600	997,400	112,100	1,014,000	1,025,500	1,019,800
Containers		171,000	62,400	72,000	67,200	130,800	79,900	97,900	88,900
Vehicles		216,400	136,500	184,800	160,700	8,500	203,800	280,200	242,000
Payroll			488,300	689,000	588,700		741,600	1,045,900	893,700
	Sub Total	1,648,400	1,685,200	1,952,200	1,818,700	259,900	2,044,800	2,455,000	2,249,900
	TOTAL	$31,455,400	$ 6,906,200	$ 8,240,600	$ 7,573,500	$20,242,500	$12,158,900	$14,819,500	$13,489,100

*Includes Engineering Fees & Contingencies @ 20% of Capital Cost encountered in implementing this project only. The estimates of cost provided herein assume that all governmental units within Oakland County will participate in the program except those now joined in the SEOCIA.

We have tabulated capital cost and annual cost for each decade of operation below. This listing is divided into major units including administration, incinerators, residue disposal, transfer stations and convenience centers. An allowance of 20% has been made for engineering and contingencies on all capital cost for which this would apply. Figures presented for annual cost include amortization, operation and maintenance together with utilities and necessary supplies.

Incinerator costs are shown in the first listing. The cost of incinerator construction and annual operating cost is distributed as follows:

Incinerator	Capital Cost		Average Annual Cost	
	1970-1980	1980-1990	1970-1980	1980-1990
Avon	$ 100,000	$17,228,400	$ 8,000	$3,550,900
Farmington	11,924,900	0	2,351,200	3,072,600
Independence	13,024,900	2,250,000	1,767,900	1,868,300
Total	$25,049,800	$19,478,400	$4,127,100	$8,491,800

Transfer station cost is estimated as follows:

Transfer Station	Capital Cost		Average Annual Cost	
	1970-1980	1980-1990	1970-1980	1980-1990
Highland	$605,300	$200,700	$424,800	$ 652,400
Oxford	394,300	112,900	342,000	597,000
Total	$999,600	$313,600	$756,800	$1,249,400

The cost of the program can be expressed in terms of cost per ton of refuse delivered. This method of cost accounting provides a ready way to charge customers. The cost of the phases of the program are reduced to the cost per ton and listed below.

Item	$/Ton handled	
	1970-1980	1980-1990
Administration	$ .40	$ .35
Incinerators	5.19	7.37
Residue Disposal	.69	.95
Secondary Transportation	.95	1.08
Convenience Centers	2.29	1.95
Total	$9.52	$11.70

The cost figures in the above tabulations indicate the approximate cost for construction and operation of the program under Plan B. These cost estimates are based on information contained in the text of this Report and from tables listed in the Appendix.

Omission of Pontiac

The City of Pontiac is currently constructing a sanitary landfill north of Collier Road. This landfill will replace the Kennett Road operation when the latter is filled. The new Collier Road site will last the City 25 or more years and with the City's long experience with sanitary landfill, they may wish to continue independent operations.

If Pontiac chooses not to become a part of the County program, we recommend that Farmington Incinerator be installed as originally proposed with four 400 ton per day furnaces all installed in 1970. The material from Bloomfield Township will all be burned at the Avon incinerator. The Avon and Independence incinerators will be reduced in size if Pontiac does not participate so that each must be built in the first decade. Three 325 ton per day furnaces would be required at Avon in 1970 and two of the same size at Independence. Each of these plants will need to add another furnace in 1980. Provision should be made for ready expansion of the Avon and Independence plants in the event Pontiac should later elect to become a part of the County operation.

If the City of Pontiac is omitted from Plan B, the capital cost of the program would be reduced as follows:

	1970 - 1980	
	Plan B	Without Pontiac
Avon	$ 100,000	$ 6,970,000
Farmington	11,924,900	11,924,900
Independence	13,024,900	5,360,000

	1980 - 1990	
	Plan B	Without Pontiac
Avon	$17,228,400	$910,000
Farmington	0	0
Independence	2,250,000	910,000

The savings in annual cost over the planning period will amount to $1,550,100, as follows:

Amortization of Capital Cost	$861,000
Salaries	51,100
Residue Disposal	54,500
Operation & Maintenance of Equipment	583,600

Despite the lesser annual cost produced by reduced operations as a result of omitting Pontiac, the unit cost per ton will increase because of a larger proportionate reduction in annual tonnage. The unit costs for the first decade are listed below.

	Unit Cost Per Ton
Administration	$ 0.58
Incineration	8.25
Residue Disposal	1.14
Secondary Transportation	1.38
Convenience Centers	3.32
Total	$14.67

PLANS A & B

Construction Material, Fly Ash, Foundry Sand, Liquid and Hazardous Waste Disposal

Significant quantities of material are produced daily in Oakland County which cannot be burned in an ordinary incinerator. Construction and demolition debris, fly ash, foundry sand, dead trees, non-volatile liquids and industrial sludges are among those items which cannot be burned or are difficult to burn in municipal incinerators. Based on replies from industrial questionnaires and discussions with municipal and industrial officials, it is prudent to expect that the following quantities of these materials could be delivered to the County for disposal:

Type of Waste	Average Daily Quantity-CY
Construction & demolition debris	60
Foundry Sand	340
Fly Ash	100
Industrial Sludges & Liquids	50
Trees, trimmings and brush	100

The disposal of these materials will require approximately 2,700 acre feet of land volume in the 20 year life of the program.

Foundry sand wasted by County industry is generally not oily and can be disposed of almost anywhere. It could be used as daily cover for incinerator residue. Foundry sand may be deposited in gravel pits or other low areas, or used to cover trees or other bulky items placed in such holes. Foundry sand can be mixed with sludges to make them more manageable by the landfill equipment.

Fly ash is not so easily disposed of as foundry sand. Depending upon its size, fly ash could become windblown if left in the open for any length of time. Windblown fly ash can create a major nuisance in the vicinity of the disposal area. Fly ash may be mixed with other materials to make its disposal somewhat easier or it can be buried immediately upon delivery to the disposal site.

Construction and demolition debris is usually large bulky material and is often difficult to handle. Material from the destruction of buildings or from pavement removal projects is not easily worked by bulldozers and can damage equipment. Certain of this waste is free from objectionable material and can be used to raise low areas above high water levels without danger of water pollution. Once in place, this debris can be covered with foundry sand or earth cover and the land so reclaimed used for further disposal or converted to other uses.

Industrial sludges and liquids will be most difficult to handle. Most of this material in Oakland County is now being disposed of by the manufacturers. It is being accepted by industrial disposal firms in the Detroit Area for reclaim or final disposal. These firms are more knowledgeable of the characteristics and safe handling of these materials than municipal employees would be. We encourage the continued disposal of industrial sludges and liquids by private firms with the equipment and knowledge to handle this material properly.

Trees and Brush

Trees and trimmings are combustible materials but they are difficult to handle in municipal incinerators unless properly prepared. Brush and tree trimmings will burn readily and can be managed if they are cut into lengths and loosely bundled. Large limbs, trunks and stumps are seldom consumed even when cut to easily handled lengths.

Brush, medium branches and large lumber may be burned in municipal incinerators if they are first passed through a chipper.. This is a stationary model somewhat larger than the portable units frequently employed by commercial tree trimmers and power companies. Chippers will cost about $90,000 and one should be installed at each incinerator.

Large tree parts can be buried. Stumps and trunks are difficult for bulldozers to handle. If they are dumped into holes or dry pits, earth or foundry sand can be used to cover them from above. Final earth cover can be spread after all wood is buried and rough cover graded to restore a natural look to old borrow pits. This method of tree disposal will be least expensive and is recommended.

If sufficient space cannot be found to bury tree parts, or if it becomes desirable for some other reason, then a tree burner can be built.

Large tree parts can be burned in special incinerators such as the brush burners operated by the City of Detroit. Tree parts are placed in the brush burner several times daily and allowed to burn for extended periods. Air is supplied as in an ordinary incinerator, but there are no grates in the Detroit units. A brush burner will cost approximately $350,000 at today's prices based on applying the Engineering News Record Construction Cost Index to the construction cost of the Detroit units. The Avon or Independence incinerator sites offer the best location for a tree burner.

Cost of Special Waste Disposal

Foundry sand should be handled at cost. Since this material is relatively easily managed at a fill site, the cost of residue disposal will be in the range of $0.50 to $1.00 per ton buried. Less manageable materials such as tree stumps, sludges, liquids, construction and demolition debris, fly ash and bulky items will cost more to dispose of at the fill site. The charge for disposal of these items should be proportionately higher than for foundry sand.

Order of Construction and Land Procurement

It is unlikely that either program proposed in this section of the Report will be entirely implemented at one time. Much time is required for making contractual arrangements with participating governments, for preparing plans and specifications, and for construction. A suggested order of construction to permit orderly planning of the project is proper.

We urge that all land for all future construction be purchased as soon as financing is available. Early purchase will probably reduce land costs below those that would be encountered if land is acquired as the need arises. Early purchase will also protect the County from private purchase and development of desirable parcels for a good solid waste program.

The County should first determine the Plan they will develop and obtain contracts with participating governments for the Farmington Incinerator. This unit should be constructed first because of the dense development of the contributing area and because of a need for additional facilities in this area. The Milford or Highland Transfer Station should be constructed with, or soon after the Farmington Incinerator. This construction should be followed by the Avon or Independence Incinerators and their supporting transfer stations. Convenience centers should be constructed early in the program.

WAYNE COUNTY AND MACOMB COUNTY

At this time the Detroit metropolitan region faces a challenge of soaring population and a shrinking allotment of space per person, and a conflict of how to apportion the remaining available space. Vast land areas must be used for sanitary landfill for raw refuse or even the residue from incineration plants. The rapid urbanization in the Wayne-Oakland-Macomb County areas has already developed for private purposes much space which could have been used for public benefit.

Wayne County

An engineering report on solid waste disposal for Wayne County, Michigan, was presented to the Board of County Road Commissioners in 1967. This report outlined the planning for refuse disposal for Wayne County over the next 20 years. Certain areas of Wayne County were excluded from the study, among them the cities of Hamtramck, Highland Park, River Rouge, Ecourse, Trenton, and those cities comprising the Central Wayne County Sanitation Authority. In each of these cases, the city or authority is now served by an existing incinerator. However, the City of Detroit, although serviced by four incinerator plants, is included in the study because those four plants are not adequate for the refuse generated by the city.

The report recommends that the four city incinerators presently operating in Detroit be purchased by Wayne County as a part of its refuse disposal program. The four plants are located as follows:

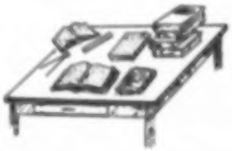
(a) St. James at Edsel Ford Expressway
(b) Davison at Detroit Terminal Railroad
(c) West Jefferson at 24th Street
(d) Winder in the vicinity of Eastern Market

The report states that actual burning capacity of each of these plants is materially below original design and recommends that they be reconditioned and modernized.

In addition to the four City of Detroit plants, the Wayne County report recommends the immediate construction of five additional incinerator plants at various locations in the County. These are:

(a) Near the State Fair Grounds in the City of Detroit
(b) Near Southfield and the C & O Railroad in the City of Detroit
(c) Near the C & O Railroad and Haggerty Highway in Plymouth Township
(d) In the City of Dearborn near Butler and Greenfield Roads
(e) In Brownston Township near Eureka Road and Allen Road near the D T & I Railroad

The location of some of these incinerators was moved from those of the original Detroit Metropolitan Area Regional Planning Commission report. The Wayne County study confined itself to problems originating in Wayne County only and consequently incinerator plant locations which were to provide inter-county service were abandoned and new sites located within the bounds of Wayne County. Efforts were made to place incinerators near or within reasonable hauling distance of rail facilities. The report states that if Regional Plan II of the DMARPC Report can be effected at some time in the future, the plants proposed in the Wayne County study will conveniently fit into the prior plan.



The study states that no decision has been made as to the disposal site for incinerator residue. There is mention, however, of two sites in the County, one in the southeastern portion and the other in the northwestern portion. The volume of residue to be produced by the incinerators of Wayne County, excluding those in the omitted cities and authority, will be approximately two to three times as much as generated by all of Oakland County.

Macomb County

The southern portion of Macomb County situated immediately east of Oakland County is largely urbanized. Two refuse disposal operations currently exist in Macomb County. These are the South Macomb Disposal Authority and the Grosse Pointe-Clinton Refuse Disposal Authority.

The South Macomb Disposal Authority operates a sanitary landfill in Washington Township of Macomb County. This Authority has operated sanitary landfills successfully in the more densely populated southern portion of Macomb County for many years. In the course of this investigation, we spoke with Mr. William Harper, Manager of the South Macomb Disposal Authority. Mr. Harper indicates to us that the Authority is not interested in joint disposal service with Oakland County.

Mr. Vern Olson, Manager, and Mr. Robert F. Ryan, Director for the Grosse Pointe-Clinton Refuse Disposal Authority, have provided information concerning the operation and intent of their Authority. The present operation of the Authority is by contract with a private individual for sanitary landfill of refuse now originating from members. The Authority is engaged in the process of obtaining the contractor-operator for a 600 ton per day incinerator. They propose the contractor build the plant and operate it for the Authority for a period of 25 years. Seventy-six acres of land have been purchased for residue and bulk refuse disposal. This area is partly an abandoned gravel pit and is ready for use as soon as the incinerator becomes operable. The indication is that the Grosse Pointe-Clinton Refuse Disposal Authority will be self-sufficient over the life of its contract.

In early May of this year, approximately 30,000 persons in six northern Townships began to use the South Macomb Disposal Authority's service according to Mr. Jerome Schoof, Supervisor for Bruce Township. With this extension of service, most of Macomb County residents are provided refuse service by one of the authorities. There appears to be no immediate need to consider a cooperative system with Macomb County.

Evaluation of the Situation

It is almost a certainty that Wayne County or the City of Detroit will approach Oakland County officials regarding residue disposal. It is much less probable that a similar overture will be made by Macomb County officials for raw refuse disposal. If such approaches are made and Oakland County has adequate capacity in its facilities to handle such material, there are good reasons for a cooperative disposal program.

The quantity of residue that will be generated by Wayne County and Detroit is estimated in the 1967 *"Engineering Report on Solid Waste Disposal - Wayne County, Michigan."* The report projects 14,000 acre feet of residue until 1990, plus 4,200 acre feet of cover material. This figure does not include the Central Wayne County Sanitation Authority or the cities of Hamtramck, Highland Park, River Rouge, Ecorse or Trenton. These cities provided estimates indicating that incinerator residue from them will amount to 7,300 acre feet including cover material for the period until 1990. Many however have long-term residue disposal arrangements which they wish to continue to use.

If all these communities should use the Oakland County area for residue disposal more land will be needed. The residue from the City of Detroit and Wayne County as projected in the County report together with Oakland County residue will require an area of approximately 2 square miles if fill depths average 20 feet. The residue from the authority and five cities will require an additional 360 acres of land if their needs are to be met.

Provisions of Public Act 342, under which the county is operating, require cooperating counties to enter a contract for joint service. The act provides for establishing an administrative agency and gives authority for that agency to conceive, construct, operate and finance projects within the limitations of the contract. We recommend that Oakland County be prepared to purchase adequate land to provide for residue disposal for neighboring incinerators if such contracts materialize.

The cost of disposing of Wayne County residue in Oakland County will be little different from the cost of disposing of Oakland residue. However, in addition to the outright cost of operating and maintaining equipment and purchasing land for residue disposal, there is a further consideration that land capacity vital to Oakland County's program is being used by outside parties. The County should be reimbursed for such use of their resources, and such a charge should be a part of the negotiations. Wayne County should expect to pay for all legimate costs of service granted by Oakland County.

The situation in Macomb County may alter in the future. Should Oakland County have sufficient capacity in its furnaces, contractural arrangements with Macomb County could be made for complete disposal of refuse delivered to incinerators of Oakland County. This arrangement would work well both for small quantities from the northernmost townships or in the unlikely event that the South Macomb Disposal Authority would seek to purchase burning capacity from Oakland County.

It is most likely that the northernmost townships only of Macomb County will desire service from Oakland County. Contractural arrangements should be similar to those suggested for Wayne County. The population projection of the six northern townships by the Macomb County Planning Office indicates that 370 tons per day of refuse can be expected from this area by 1990, based on a 5-day week. The nearest incinerator to these townships is the Avon Unit. This incinerator should be designed with provision for expansion to accommodate Macomb County refuse.

Any contract joined between Oakland County and parties of Macomb County should also consider the fact that capacity built by Oakland County is being taken for outside waste materials. These contractual arrangements should provide for a surcharge to account for this use of capacity in addition to the charge for incinerating the refuse.

We do not feel it is within our authority to suggest a price for such surcharge for outside communities. We can strongly urge that the base rate for incineration be the same as that charged Oakland County participants to the refuse disposal program. We urge that the Oakland County officials consider the use of their facilities by outside counties as a service to be sold in a similar manner as water and sewer service are sold by Detroit.

There is adequate space in Oakland County facilities to permit cooperation with Wayne and Macomb Counties. The Oakland County refuse disposal program should consider the possibility that cooperation with these two counties is a distinct future possibility. Cooperation as suggested herein will help bring about the trust required to promote a regional program for the Detroit metropolitan area.

PROBLEMS FOR FURTHER EXPLORATION

This study and investigation included many aspects of the refuse disposal problem. Some of these aspects have been thoroughly explored by others over the course of years. Other aspects are not so well known. In some cases, we believe a new and different approach is available to an old problem. The Solid Waste Act of 1965 authorizes the Federal Government to participate with public bodies, through demonstration grants, in investigations of new or different approaches to solid waste problems. We present in this section of the Report four problems we believe should be accorded further study under this program. The purpose of the demonstration grant is to explore the worthiness of the methods we propose as a means of helping solve the problem of refuse disposal or reducing its cost. Obtaining a Federal Grant cannot be assured and many conditions must be met before one is awarded.

The Use of Steam

Hours of discussion have been spent regarding the use of steam from modern refuse incinerators. To our knowledge, little attempt has been made up to this time to produce steam for private uses outside the incinerator. The Norfolk Naval Incinerator supplies steam for port use of Navy ships at the base. The City of Atlanta obtains heat for buildings from one of its incinerators and has done so since 1941. We believe that steam generated from incinerators could be used to heat detached residential and other types of buildings.

We propose a demonstration be conducted cooperatively with the Avon Incinerator of the Oakland County System and the Oakland University Campus. The University is a complex of several buildings located approximately 4-1/2 miles from the Avon Incinerator site. The University offers liberal arts training and has both class room and dormitory facilities for approximately 4000 students. A representative of the University indicates that expansion is contemplated in the future. Oakland University has its own power generation plant and steam is furnished to several buildings of the University from this source. We propose that the demonstration be established to prove or disprove that steam from refuse generation can successfully be used to heat detached buildings economically by carrying steam from the Avon Plant and furnishing it to the University's system at the outlet to their present steam generating facilities.

In order to enlist the aid of Oakland University Authorities, we propose that steam be furnished at a minimum charge to the University. This will be possible if the Federal Grant is available to pay a portion of the cost of construction. The Federal demonstration grant could amount to 2/3 of the total project cost. We estimate that the tunnel and piping necessary for steam heat and other equipment required to perform this demonstration will cost approximately $63,800 annually. We estimate that this will bring the cost of steam furnished to the University to a value between $.20 and $.25 per pound. We would not propose a charge for steam generation at the incinerator because this steam would be generated by the burning refuse even if a demonstration were not conducted. One-third of the cost would be paid by Oakland County and returned to them through a minimal charge of between $.07 and $.08 per pound for steam delivered to the University. This minimum charge would repay the County for its participation in a 20 year period.

The project is designed to demonstrate problems which could arise in long distance steam transmission and return facilities on a closed circuit steam heating system. The equipment would include super-heating units at the boiler, steam lines, steam tunnel, return lines and condensate pumps. Difficulties in maintaining a constant supply of steam, or meeting fluctuating demands of the University or similar complex of buildings, and any operating problems which may evolve regarding the use of saturated or super-heated steams over long distance transmission, should be proven in a period of between 5 and 10 years.

Rural Convenience Centers

Oakland County seems ideally situated to demonstrate the feasibility of using convenience centers for rural refuse disposal. We propose a demonstration which would encompass two types of convenience centers, those using rolloff bodies and those using commercial type containers and sanitary landfill. Certain township areas in Oakland County presently are served by sanitary landfill. Under the demonstration, these government units would continue to operate a properly run sanitary landfill. A demonstration can be made of the effectiveness of each type of convenience center by selecting other rural townships for service by such facilities. We propose a five year demonstration to compare refuse convenience centers, and sanitary landfills for effectiveness of keeping roadsides clean and to compare costs and document problems of operation and maintenance which may accrue to each. In order to achieve this goal, we propose that the full operating cost records be made available on one or more existing sanitary landfills, and that the operation be turned over to the County using sanitary landfill units as described earlier in this Report. This demonstration could include also the effectiveness and cost variation between operating landfills on a 1, 2, 5, 6 or 7 day week. The demonstration would include observation of roadside litter and efforts would be made to evaluate the effectiveness of the sanitary landfill unit and the convenience centers in preventing the litter nuisance. By including both rolloff and detachable container type convenience centers, we believe that the effectiveness of each type of container can be demonstrated for future reference.

High Temperature Burning

Increasing use of plastic in consumer goods and of plastic films in food marketing, together with a greater consumption of single use paper products is causing a significant rise in heating value of refuse. Incinerator designs at 3500 BTU per pound of refuse fired were used in 1940. In the early 1960's the design was for about 4500 BTU per pound, and today designs of 5000 BTU per pound are common. The increasing heat release rate means larger furnaces will be needed unless higher temperatures can be tolerated.

High temperatures are considered above 2000° F. in municipal waste incineration practice. Water wall furnaces can withstand high temperatures, as evidenced by their use in central power plants. However, excess air quantities must be limited to prevent nitrogen fixation which occurs at temperatures above 1800 to 2000 degrees F. Lower air quantities and higher temperatures will probably require different furnace configuration than normally associated with refuse incinerators. The tall furnace similar to those of central power plants may offer a better furnace shape for high temperature burning than the low profile furnaces now in common use.

Problems of maintenance and deterioration of municipal incinerators under high temperature conditions cannot be known without studies on full scale installations. We suggest that one furnace be designed for high temperature materials at the Independence Incinerator site and that a thorough study of the phenomenon of high temperature burning be conducted here. The high temperatures can be achieved through reduced excess air quantities or by firing high BTU materials, such as paper and plastics, into this furnace in larger quantities than is normally acceptable.

Septic Tank Sludge Incineration

Despite the fact that public sewer systems serve much of Oakland County, there are thousands of septic tanks serving suburban and rural families. We have calculated that approximately 11,600,000 gallons of septic tank sludge is collected annually in the County. All of this sludge needs to be disposed in a safe and adequate manner.

In the past much of this sludge has been delivered to larger sewage treatment plants, such as the Auburn plant in the City of Pontiac for final disposal. Other loads of septic tank sludge have been deposited in manholes on the sewer system of the City of Detroit. The latter is not good practice and the former is meeting increased opposition from sewage plant operators since septic tank waste upsets the operational processes of the plant. The Health Department does not permit disposal of septic tank sludges on open land or into any water course. The septic tank sludge hauler must find some place to put his sludge for safe disposal.

Several attempts have been made to burn sewage sludge with municipal refuse at many incinerators in the United States. The performance of these installations has been less than hoped for in most cases. However, we believe that under properly controlled conditions sewage or septic tank sludges can be burned with municipal refuse. Such a system of mixed refuse and septic tank sludge burning would offer a place for safe disposal by the septic tank sludge hauler.

We propose a system for septic tank sludge incineration with municipal refuse at the Independence Incinerator Plant. This plant is centrally located to the areas not served by a public sewage system. It will offer relatively short hauls for most septic tank haulers in Oakland County. The requirement that septic tank sludge be disposed of at the incinerator until such time as the system can be proven or disproven will be necessary.

We have assumed that all 11,600,000 gallons of septic tank sludge will be delivered to the incinerator for disposal. Our designs for the future do not allow for any increase in the volume of sludge which will be delivered. The Detroit Sewage System is expanding into Oakland County and will permit many homes to replace private sewage facilities with public sewage service. We have assumed, however, that the number of septic tanks in the County will remain stable due to new construction in rural areas approximating those which will be removed from service because of the enlargement of the Detroit sewer system. It is almost a necessity that the entire amount of septic tank sludge come to the plant in order that the size of the equipment can be made reasonable.

We have made the following assumptions in our analysis of the septic tank sludge incineration with municipal refuse:

Annual Sludge Volume	11,600,000 gals.
Total Solids	4.25%
Volatile Solids	60%
Heat Content	8,000 BTU per lb. of dry solids
Sludge Delivery to the Plant	50,000 gpd - 230 days per yr.

It is difficult to get combustion with fuel of greater than 45% moisture content. Summer moisture content in municipal refuse may exceed 30%. In order to obtain a reasonable fuel we assumed a moisture content of the mixture of sludge and refuse at 40% moisture. This will allow a safety factor of 5% moisture.

Septic tank sludge mixed 1 lb. to 3 lbs. of refuse must have a 60% moisture content in order not to exceed the 40% requirement. 60% moisture content can be achieved by driving off approximately 90 lbs. of water for every 100 lbs. of sludge. We believe the best method to reduce moisture content at the incinerator will be through the use of an evaporating pan which will utilize waste heat from the incinerator to increase the rate of evaporation. The result of the evaporation will be approximately 700 cu. ft. of dried sludge and 18,000 cu. ft. of water vapor daily.

The water vapor will carry with it certain odors resulting from the decomposition of organic material in the septic tank sludges. This material must be deodorized before it can be discharged to the atmosphere. Greenhouses to cover the evaporating pans and louvred to admit air could entrap the vapors from the process and they could be withdrawn through an afterburner to destroy any odors present in the vapor stream. The deodorized vapors could be discharged through a stack to the atmosphere. A plume of water vapor will result from this operation. An alternative would condense the vapor for in plant water uses.

The dried sludge which remains in the evaporating pan following drying could be removed by a front end loader and conveyed to a ball mill where it could be pulverized for easy handling. After leaving the ball mill the dried sludge would be conveyed to a point and mixed with incoming refuse at specified rates so as not to exceed the critical 40% moisture content. Combined sludges and refuse would then pass through a hammermill which would reduce the size of particles in the refuse and effectively mix both refuse and sewage sludge into a homogeneous mixture. This step is, we believe, a critical one. Past experience in burning sewage sludges indicates that if sludge is permitted to enter the furnace in a batch not thoroughly mixed with the refuse, it smothers the fire, tends to ball, refuses to burn or explodes. A thoroughly homogeneous mixture produced by the hammermill operation will help to prevent this problem.

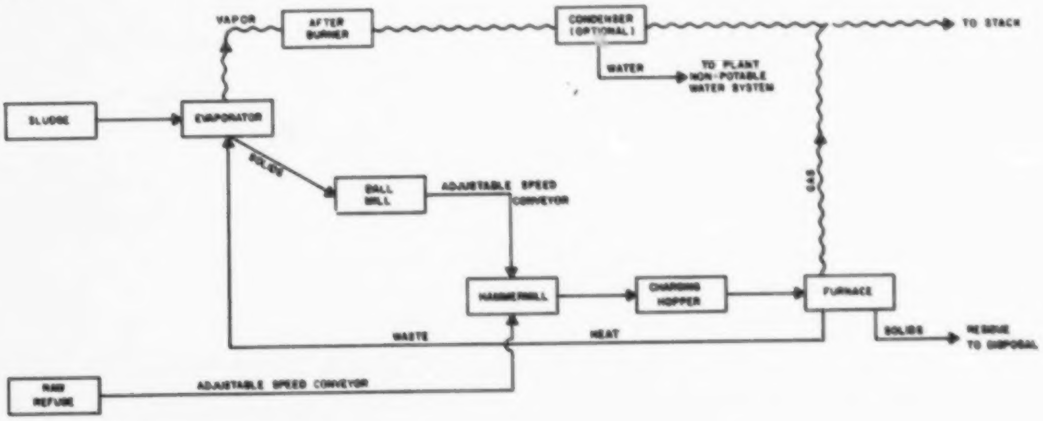
The mixture of sludge and ground refuse can be conveyed to the charging hopper of one furnace. At this point the sludge and refuse will be mixed with normal refuse delivered to the charging hopper by a crane.

The flow diagram shown in Figure No. 19 indicates the processes we envision for the successful incineration of septic tank sludge with municipal refuse. The total quantity of sludge which will be fired under the system as we envision it for Oakland County will not exceed three tons per day, which is far less than the 325 ton per day capacity of the Independence furnaces.

We have estimated that the capital cost of installing the sludge drying and incineration equipment including the evaporation pans, greenhouse, the ball and hammermills, condensate and steam piping, afterburner, fans, conveyors and electrical controls will be approximately $582,000 including 20% allowance for engineering and contingencies. We have estimated that the operation can be done for approximately $100,000 in annual cost. This amounts to about one cent per gallon of sludge delivered to the site for ultimate disposal or $10.00 per thousand gallon septic tank truck load.

We believe that two major considerations must be given in burning sewage or septic tank sludge with municipal refuse. These are: (1) thorough mixing, (2) reasonably close control of moisture content with a way to adjust moisture content within the plant if it is evident that the mixture is getting too wet.

One furnace at the Independence Incinerator may be used to demonstrate the feasibility of this type of operation. If successful, the system might be applied to small sewage treatment plant sludges or industrial sludges of low volatile content.


VAPOR
AFTER BURNER
CONDENSER (OPTIONAL)
TO STACK
WATER
TO PLANT NON-POTABLE WATER SYSTEM
SLUDGE
EVAPORATOR
SOLIDS
BALL MILL
ADJUSTABLE SPEED CONVEYOR
GAS
HAMMERMILL
CHARGING HOPPER
FURNACE
WASTE
HEAT
SOLIDS
RESIDUE TO DISPOSAL
RAW REFUSE
ADJUSTABLE SPEED CONVEYOR

FLOW DIAGRAM FOR SLUDGE INCINERATION

FIGURE 19

Summary

We believe that these four proposed demonstrations can be successfully incorporated into the Oakland County plan for refuse disposal. These projects will demonstrate the feasibility and problems which may be encountered in different areas of refuse disposal programs; the rural collection system, mixed sewage sludge and refuse incineration, and incineration by-product use. These aspects of the refuse disposal problem have been discussed in the past but no effective demonstration of feasibility or problems which might arise from any of the solutions is known at this time. It is our hope that the projects outlined will be effective in demonstrating the feasibility of these solutions.

LEGAL CONSIDERATIONS

Legal aspects of solid waste disposal have been given considerable attention under current Michigan legislation. The State recognizes garbage and refuse disposal as an important function in the preservation of public health and welfare, equally as important as sewage disposal and water treatment. The State includes refuse service among those functions delegated to its various political jurisdictions.

Current Legislation

A necessary part of this Report is a brief presentation of legislation pertinent to implementing a County solid waste disposal system. Many laws have been passed by the legislature in the past which pertain to this service. We do not propose this portion of the Report as a substitute for the advice of counsel, but offer it as a method of helping the reader understand the enabling legislation under which this project can be implemented.

Act 342, Public Acts of 1939

The Oakland County Board of Supervisors is now operating under provisions of Act 342. The Drain Commissioner has been appointed as the County Agency for making the study which is detailed in this Report. Act 342 is the basis of authority for implementing the provisions of the Detroit Metropolitan Regional Planning Commission Plan 2, of which Oakland County is an integral part.

The Act authorizes counties to establish and provide among other things facilities for solid waste collection and disposal within or between cities, villages, townships, and township improvement districts. These cities, villages, townships, or any combination of them may be within the limits of the county or beyond county jurisdiction. The Act enables the county to acquire, purchase, construct, own and maintain and/or operate incinerators and disposal grounds and to establish, administer, coordinate, and regulate a system or systems of garbage and rubbish collection and disposal facilities and services among these governmental jurisdictions. The services authorized under Act 342 must be furnished under Agreements to each of the political jurisdictions affected by the program. These agreements may be for periods up to 40 years.

The County is granted the right to purchase, accept as a gift, or condemn private property needed for the facilities authorized under this Act. If condemnation is used, the provisions of Act 149, 1911, will take precedence.

The County Board of Supervisors may designate various agencies of the County as the Authority for providing service under Act 342. Certain agencies of the County are designated as follows: the County Road Commission; the County Drain Commission; or in counties over 1,000,000 or less than 400,000 population, the County Department of Public Works. The lower population range is a restriction of Public Act 185, the Department of Public Works enabling legislation. These agencies may make the contracting agreements for service between the cities, villages, and townships to which service will be extended. The Oakland County Supervisors have designated the County Drain Commissioner as the designated authority for their County.

Two or more adjoining counties may contract to establish refuse disposal facilities and services and to provide for an administrative agency composed from membership of their respective county agencies. The multi-county administrative agency has and is required to exercise all powers and duties conferred upon the county agency under provisions of this Act, except as specifically limited by any provisions of the contract. Bonds issued to finance construction of improvements under multi-county contract shall be a joint obligation of all participating counties.

The Act permits revenue bonds to finance these services. General obligation bonds pledging the full faith and credit of the county are also permitted under this Act. If general obligation bonds are used in financing the project, the Board of Supervisors must approve their use by a 2/3 vote of the members of the Board. General obligation issues are subject to a referendum by the voters of the county. Rates and charges to contracting municipalities must be adequate to pay bond and interest retirement as well as operation and maintenance of the facilities. If revenue bonds are issued, a coverage of 50% is required but such coverage is not necessary when general obligation bonds are issued. Bonds may be issued under Public Act 94, 1933.

Any contracting unit of government except the County may raise the funds required as a result of the Agreement by collecting revenue rates, charges or assessments from the users and beneficiaries of the facilities or may levy a tax upon the taxable property for this purpose, which tax is not subject to the charter or statutory tax limitation. The Agreement can stipulate that the County agency rather than local governmental units may collect charges, rates, or assessments directly from the users for the services furnished. There is no provision for the County to levy a tax or assessment directly upon taxable property or make a direct charge to users of the service.

Act 342 specifically states that "The construction or acquisition of any improvements or facilities in accordance with the provisions of this Act, shall not be subject to the requirements and provisions of Act 261 of the Public Acts of 1927." Act 342 also provides for the condemnation of private property determined by the county agency to be necessary for public use.

Act 320, Public Acts of 1927

Act 320 is a second Act which provides counties the authority to furnish garbage disposal plants and facilities. Since the County has undertaken the project under provisions of Act 342, Act 320 is of interest primarily because of its provision that garbage disposal systems and sewage disposal systems are subject to construction under court issued orders. The Authority on this portion of the Act has been demonstrated in many instances wherein communities have been ordered to construct sewage plants under the provisions of this Act. It is possible that failure of a municipality or county to provide adequate refuse disposal facilities will result in its receiving court orders to provide adequate facilities, or to join the County Program.

Act 87, Public Acts of 1965

Act 87 was passed by the Michigan Legislature in 1965 and implementing rules established soon after. This legislation establishes standards of operation for solid waste disposal areas and provides for enforcement of these rules. The Act and rules effectively preclude open dumping and seek to avoid water pollution at refuse disposal sites.

The Act applies to individuals, firms, corporations, or any political subdivisions of the State, including any governmental authority created by statute. The Act does not apply to individuals providing proper disposal of their own refuse on their own property.

The Act restricts disposal of any refuse at any place except a disposal area licensed as provided by this Act. Nothing in this Act should override the legal right of a local governing body to develop an enforcing local ordinance, codes, or rules and regulations on solid waste disposal equal to or more stringent than the provisions of the Act. Act 87 does not relieve the applicant from the responsibility of obtaining a license from a local governing body for operating a disposal area under their rules and regulations if such apply.

Act 348, Public Acts of 1965

Act 348 became effective in 1965 and implementing rules were established under provisions of the Act. This legislation establishes an air pollution control commission with the State Health Department and authorizes rules and regulations to control atmospheric pollution. The Act also provides for enforcement of the rules and regulations of the Commission and penalties in the event such rules are violated.

Under the provisions of the Act, persons, firms, corporations or any political subdivisions within the Federal, State, or local government are subject to the provisions of this Act and the rules established thereunder. Anyone intending to construct or alter any fuel burning or refuse burning process must submit plans and specifications for approval of the Commission prior to the construction. Permits to operate equipment will be issued to conforming installations by the Commission under the rules.

The rules establish specific limitations and prohibitions on emissions to the atmosphere. These limitations will generally require the use of air cleaning devices on any equipment installed.

Air pollution is defined in part by the Act as contaminate in quantities, of characteristics, under conditions and circumstances, and of a duration causing injury to human, animal, or plant life. This contamination may be considered injurious if reasonably detrimental to the enjoyment of life and property. The Act is assumed to apply to private residences as well as to industrial, commercial, and political establishments.

Other Pertinent Legislation

Under the acts permitting its incorporation, each municipality within the County has authority to collect tax levies for the collection and disposal of refuse. General obligation debt may be voted by the communities for the construction of disposal facilities such as incinerators or landfill sites or the acquisition of property for disposal operations. Municipalities may also contract with other communities for collection and disposal of solid waste.

Act 298, Public Acts of 1917

Act 298 authorizes cities and villages under 150,000 population to levy a tax not exceeding 2 mills annually for collection and disposal of garbage. This tax levy may exceed charter and State statute limitations on authorized tax levies and may be placed on the State equalized valuation. Should the tax be for construction of garbage disposal facilities, the bonds for such must be repaid in 5 years at an interest rate not exceeding 5%.

Act 261, Public Acts of 1927

Act 261 prohibits construction of garbage disposal plants in cities or villages by another municipality or by private contractor unless authorized by a vote of the majority of the electors voting thereon. This shall not apply to the Authority created under Act 179, Public Acts of 1947, when the community is a member of the particular Authority. The provisions of Act 261 do not apply to municipalities using Act 342.

Act 106, Public Acts of 1963

Act 106 prohibits littering public and private property or waters and prescribes penalities for violations. This Act makes it unlawful for any person knowingly and without the consent of the Public Authority having supervision of public or privately owned property to dump, deposit, place, throw or leave litter on any public or private property or water. The term litter as used in this Act means all rubbish, refuse, waste material, garbage, paper, bottles, and debris or other foreign substances of every kind and description. The Act does not limit the powers of cities, villages, and townships to enact and enforce ordinances for the control and elimination of litter.

An interesting and little used section of this law provides that a person guilty of the misdemeanor of littering may be directed by the court to clean up by litter gathering labor that litter which he deposited or any other litter the court may direct.

Abandoned Vehicles

An automobile is considered abandoned in the State of Michigan if left on a public highway or street for a period exceeding 48 hours without notification of proper authorities of the reasons for leaving it. If the auto is on private property, it is considered abandoned if left over 48 hours without the owner's consent. If a vehicle is judged abandoned under these conditions, it may be taken into custody by law enforcement officials. The proper officials then have 10 days in which to notify the Department of Motor Vehicles to check for current registration. If the vehicle is currently registered, the Department will notify the Owner and he and any lien holders may claim the vehicle within 45 days from the date of such notice by paying for all charges incurred. If the owner or a lien holder fails to claim the vehicle within the 45 day period, it may be sold at public auction at any time after the expiration of the waiting period.

Vehicles without registration or registered in another State may be sold at auction after a single publication of notice and a wait of 30 days.

An abandoned vehicle with value less than $100 may be delivered to a garage keeper within the County where the abandoned vehicle was found. The garage keeper has the responsibility of notifying the Department of Motor Vehicles within 10 days of the date any vehicle is delivered to him. If the vehicle is registered, the Department will send notice of impoundment to the owner who shall have 15 days to claim his property. If it is not claimed, the garage keeper may at the expiration of the 30 days from the time of notification claim title to the vehicle and sell it upon proper publication of notice.

Vehicles 5 years old or older which have extensive damage by either collision or vandalism which renders them inoperative and whose fair market value is under $25 may be sold as scrap by the peace officer or sheriff after determining that the vehicle has not been reported stolen.

Suggested Legislative Amendments

Act 342

The County Public Improvement Act of 1939, Act 342, is an excellent Act for cooperation between counties and between counties and cities, villages, and townships for water, sewer, and refuse disposal facilities or improvements. This Act gives as broad an authority as any Act on the books to accomplish its purpose. It provides the ability to build complete systems without referendum. However, there is room for some improvement in Public Act 342.

The greatest handicap of Act 342 is its failure to provide any way for the county itself to finance improvements benefiting more than one community. Under the present legislation, the county must rely upon assessments, rates, charges, or special taxes levied or established by the community to which service is provided, unless the county adopts a "Home Rule Charter". Improvements as proposed in this Report constitute a county-wide system, and the possibility does exist that all communities may not wish to participate. Failure of some to participate could cause a needed project to fail, unless some way is found to spread the cost equitably to all benefited areas of the county. We offer for consideration of the legislative authorities the following methods for the county to establish the revenue which will be required to operate this system.

The county should be authorized to fix rates and charges to individuals, corporations, or firms for the service of refuse disposal. These rates and charges should be published and should be similar for similar types of waste. Rates and charges could be higher than for residential refuse if the waste material is hard to handle, hazardous, or in any other way increases the cost of operating the disposal facility.

Rates and charges to participating municipalities as a whole could be charged by the county. In this method, the municipality would receive a bill on monthly or stipulated basis for services provided by the county facilities. Rates and charges would be adequate to cover all cost of operation and would be uniform for all participating municipalities. Special consideration might be given in the form of higher rates for waste of special characteristics originating from any particular municipality to compensate for the greater difficulty in handling this item.

The County should have the ability to levy special assessments for water, sewer, or refuse service rendered against benefited property in the service area of any county operated or constructed facility. The special assessment could be levied according to benefit and would be applied against all property. Vacant property should also be assessed at a lesser rate because of a lesser benefit by the existence of the facility. Any properly constructed and operated refuse disposal facility can be construed as a benefit to any property because it will enhance the sale value of that parcel of land. Thus, vacant land may be assessed for the special benefits which accrue to it because of the existence of good public services. Special assessments would permit the County to spread the cost of facilities over a greater base, and thus gain a more favorable cost to individual members of the community. The benefit assessed can be based on the type of occupancy, by the unit, by front footage, by area, or by valuation as the legislative authority sees fit.

A fourth method of financing projects permitted to the County should be a combination of special assessments and rates or charges. A combination could allow the County to assess the capital cost of construction and equipment against all property involved in the service area and use rates and charges from users to pay for operating costs. In theory, the plant and equipment benefit all property in the service area because they are ready for use whenever the property owner desires; the costs of operation are for the benefit of users only. Such a combination may prove more equitable than the use of one form or the other.

The procedures for establishing assessments or rates and charges should be placed by the legislature upon the County Board of Supervisors acting through the designated agent for the improved project. In this matter, the County as a whole has some control on the cost of the assessments or on the rates and charges. However, the individuals who will be affected and benefited by any improvement should have a voice in the procedure. For this reason, these individuals should be provided an opportunity to be heard under the legislation that would amend Public Act 342. Such a hearing should be limited to the need for the improvement and the boundaries of the assessment area. If it has been found that the improvement is required for the general health and welfare of the public, then these two items will be all that it is necessary to discuss with the citizens who will be affected by the assessment.

A second problem arising from Act 342 is that of inter-community cooperation. Most municipalities are reluctant to surrender complete control of a refuse program to a County agency, particularly if the municipality operates disposal facilities. Most communities would prefer to have a voice in the administration of any county refuse program because the administration of such a program has a direct effect upon each contributing municipality. A board of directors to help establish policy and to review administrative decisions and budgets could minimize possible objections by individual municipalities to joining a county program for solid waste as well as other permissive operations under this Act.

The board should give municipalities the greatest vote on issues. It could consist of seven voting members appointed by the Board of County Supervisors as follows: one representative of the County Health agency; one representative from the Board of Supervisors; one representative from each: a township, village, and a city; a representative of private haulers, and one random member.

The authority of the board of directors should be limited. The primary functions could include establishing rules and regulations, reviewing rates, charges, and budgets drawn by the county agent and making recommendations to the Board of Supervisors, reviewing proposed capital improvements and making recommendations to the Board of Supervisors, and acting as an arbitration board for complaints and inequities. The board of directors should not enter into direct administration, appropriate money, review bids and specifications, select equipment, or otherwise direct the operations of the solid waste disposal agency.

Abandoned Automobile Hulks

A new and major problem is growing from the country's prosperity. This problem concerns the destruction of abandoned automobile hulks which currently fill automobile junk yards or litter the countryside. Abandoned automobile bodies may be found in open fields, behind barns, in wooded lots, or even in the side yards of residential properties. The owners of these vehicles are unwilling to pay for the removal or destruction of these abandoned hulks, and so they are left to rust away in a forgotten corner of their property. A way must be found to make the removal of the abandoned automobiles easier, and once they are removed, to facilitate their disposal.

Much of the problem lies with the restrictive legislation currently existent in the State. The time required for processing automobiles taken into custody as abandoned vehicles is lengthy. Frequently the law enforcement officers to whom this problem is assigned have little time to occupy themselves with automobiles which do not constitute traffic hazards. Much of this problem can be alleviated by differentiating between abandoned vehicles which constitute a traffic hazard and those which are a public nuisance or eyesore. In the former case, jurisdiction should still rest with the Police Department or Sheriff, and the current laws should be revised to make their disposal easier. Perhaps the most significant change in the law and the most useful one would be to shorten the time required for notification and impoundment, on the grounds that modern communications are much more effective than those at the time these provisions were instituted.

For the purpose of this study we have concentrated on automobiles abandoned in such locations that they do not constitute a traffic hazard. These may be on highway rights-of-way, but more likely will be found in the back or side yards of residences, on vacant lots, or in open fields or woodlands. The problem created by abandoned automobiles is both a nuisance from the standpoint of aesthetics and a possible hazard to the health and welfare of the community. Abandoned vehicle bodies can impound water which breeds mosquitoes and can provide harborage for rats, mice, and other disease bearing rodents. They are an attractive nuisance to young children, who frequently find them a place to play in or to explore. In such childhood pastimes, youths are exposed to danger of cuts from exposed metal or glass as well as other injuries which may result from falls or other causes.

We believe that effective legislation is required to enable counties or municipalities to remove abandoned automobile hulks from areas which do not constitute a hazard to the driving public. We are not prepared to offer an ideal law to provide a solution to this problem. It is the duty and right of the corporation counsel of the county or other competent counsel to suggest such changes to the legislature for enactment. Instead, we will suggest several points which we believe should be studied in more detail by knowledgeable men before making a recommendation to the property legislative authority to obtain the necessary legal instruments.

A tour of the County will quickly reveal to the interested observer the magnitude of the problem caused by abandoned automobile hulks. These vehicles blight the landscape and should be removed from public view for the benefit of all residents and visitors of the County. Such a program may create hardships or infringe on the rights of some people, but it is for the benefit of the general public. However, it is a well-established fact that the public through its County or State agencies has the right to step in and alleviate problems which constitute hazards to public health and welfare or create nuisances to the community in general. We, therefore, present the following list of items which should be considered when the current law on abandoned vehicles is revised.

1. Definition. An automobile which has extensive damage by collision or vandalism, including but not limited to a broken window or windshield, missing wheels, tires, motor, or transmission, and not displaying a current registration plate, or any combination of these circumstances rendering the said vehicle inoperative, which is not contained within a manmade enclosure which screens it from public view. Abandoned vehicles should include but not be limited to automobiles, trucks, busses, motorcycles, bicycles, trailers, tractors, farm equipment, or any parts thereof.

2. Legislation should designate an authority or agency of the County which has the right to investigate abandoned vehicles. This Authority should be authorized to enter onto private property for the purpose of determining the condition of any abandoned vehicles which are visible from the highways or on which a complaint is made. As an alternative, the licensing procedure each year should include a provision whereby the last owner of record consents to removal and disposal of the vehicle should it be abandoned. This provision may be enacted through implied consent upon purchase of the vehicle as a part of the title. If the automobile is abandoned on property of another party, the implied consent could extend to damages or liability occurring because of the inspection. This Authority could be composed of three parties;

one from the Department of Health, one from the sheriff's office, and the third party to be designated for the county at large.

3. The Authority should be given the right to employ inspectors who would examine and photograph vehicles to determine that they are inoperable.

4. An agency for the County should be assigned the task of picking up vehicles and assuring that they are delivered to an authorized junk yard or auto destruction plant. Any payment by the junk yard or auto destructor for the automobile bodies delivered should be made to the operating fund of the agency.

5. The agency will be able to operate a truck and crew specializing in picking up abandoned vehicles for delivery to the site for disposal or contract with a private firm for this service. The agency should also cooperate with the law enforcement agencies for picking up abandoned automobiles left on highways and city streets or complained about under present legislation.

6. The County should have the right to assess all real property in the county for services of picking up abandoned automobiles and destroying them. In addition to the assessment, the right to perform this work on a fee basis should also be included.

7. Provision may be included in the law to license all vehicles whether operable or not. Registration certificates can be checked at the title and registration office in Lansing for a period of five years after the vehicle was last registered and unregistered vehicles can be investigated. By being charged a fee, the owner will be given an incentive to junk or otherwise destroy the vehicle after it is no longer useful.

8. Title should be made out in the name of the purchaser and the State for ready transfer if the vehicle is judged abandoned. In this manner the State may transfer title to the junk dealer or auto destructor at the time the vehicle is delivered for disposal.

9. A notice by certified or registered mail should be sent to the last known address of the owner of record for the vehicle indicating that the vehicle has been adjudged an abandoned vehicle and asking him to show just cause for the agency not to remove it. Just cause might include historic vehicles in process of repair or absence of the owner in military service.

10. The certified notice from the State should give the owner opportunity to remove the vehicle himself. Fifteen days would be a suitable length of time for him to perform this service, and proof that it has been done should be presented to the authority or agency by the owner. Incentive might be provided by a minimum charge if the crew appears at the property even if no work is performed.

11. The law should provide for immediate sale of the vehicle after the waiting period has expired. Extended time periods for storage only serve to hinder the enforcement.

Oakland County has always been progressive in activities to improve the health and welfare of its people and thus contribute to the improvement of the State of Michigan. Striving for improvement to existing legislation for disposal of refuse, litter, and abandoned vehicles is another way to advance the public interests.

IMPLEMENTING THE PROGRAM

Donald M. Oakes
Public Management Consultant
Grand Rapids, Michigan

It necessarily follows that Oakland County would use county supported bonds for a county sponsored service such as solid waste disposal. The County Agency assigned the task of assuming the responsibility for the serivce by the Board of Supervisors can do an adequate job for the people of Oakland County only with this support.

The County Public Improvement Act, or Act 342 of the Public Acts of 1939, as amended, is the State statute permissive believed best adapted to accomplish the purpose for Oakland County. It permits individual municipal political units to contract with the County for the service and pledge their own full faith and credit to the County; the County, in turn, may pledge its full faith and credit to the bond buyers who furnish the funds for the improvement. The details of Act 342 are explained elsewhere in this Report. It is much preferred to other State statutes for both the practical application of getting the job done for the people and the financial advantages implicit in its structure.

Several other State statutes either require additional financial security leading to higher consumer rates or are inhibited "protections" against disposing of "garbage" in certain localities. The Legislature has passed many varieties of legislation over the years to suit certain conditions. When the need to clean up our landscapes, our air, and our environment became more evident, the Legislature passed Act 87, of 1965 to require that solid wastes be dealt with summarily.

There has been no significant legislation passed since that time to ease the financial impact on the populace. Luckily, some far sighted people sought amendment to Act 342, over the years, and succeeded. Further amendment is needed to assist those officials at the local level in really accomplishing the purpose of attaining clean air, water, and landscape which is required by Act 87, of 1965 and other related Acts.

The passage of Act 87 has literally "dropped a bomb" in the laps of those who must dispose of refuse on the local level. Every constituent of every local government contributes to the local refuse problem and some are not so understanding of the possible solutions as they should be. Each local government in Michigan is struggling to meet the additional costs of solid waste disposal while trying to maintain the same tax rate or service charge. In very few localities is this possible. Short range solutions may handle the State requirements for awhile but the long range solutions indicate that the Legislature, knowingly or not, decreed that local governments would have to get together to solve the problem if they would accomplish the solution at as reasonable a cost as possible.

This leaves only Act 342 of 1939, as amended, as the best possible collective financial condition for a County or Inter-County solution.

The Legislature in the future should be made aware of the responsibility and costs they have required of local governments for solid waste disposal and be responsive to helpful amendments to present laws to make local financing as painless as is possible.

Financial Capabilities

The basis for County supported bonds in Michigan is the current state equalized valuation. A history of the equalized valuation for Oakland County for the past 21 years is included as a part of the Appendix. It indicates an excellent growth factor with an increase of almost 518% since 1948. The 1968 equalized value of Oakland County is $3,460,371,031.

General Obligation Bonding Capacity

Michigan statutes permit a County to obligate up to 10% of their state equalized valuation for General Obligation debt. On the basis of the 1968 equalized value the County may obligate up to $346,037,100.

Direct debt of Oakland County after sale of the most recent bond issue is as follows:

Direct Debt with Bonds Pledging County Credit	Gross Debt	Portion Paid By Benefitting Municipalities	County at Large Taxes
Drains	$40,351,250	$39,339,450	$1,011,800
Sewer	46,933,000	46,933,000	-0-
Water	5,565,000	5,565,000	-0-
Motor Vehicle Highway Fund	4,915,000	4,915,000	-0-
Total County Support for Bonded Debt	$97,764,250	$96,752,450	$1,011,800

There are additional bonds either approved by the Municipal Finance Commission and not sold, or presently being considered by the Finance Commission in the amount of $10,175,000. Additional construction to be financed later this year is estimated at $1,200,000. This additional debt amounting to $11,375,000 will place the full faith and credit of the County behind $109,139,250 of general obligation debt or 3.15% of the 1968 state equalized value. This is less than one-third of the statute permitted capacity.

There are substantial retirements of all bonds each year, so that by the time additional bonds are issued the total County obligation does not necessarily increase by the total amount of a new bond issue.

While the County is obligating its full faith and credit behind the above noted bonds the debt must be repaid by the constituent municipalities which receive the additional services. By contracting with the County for the services they are pledging their revenues to repayment of bonds and interest even if it is necessary for them to levy additional local property tax above any charter or statute limitation to repay their debt. The Motor Vehicle Highway Fund Bonds are supported by the gas and weight taxes returned each year from the State to the County Road Commission.

Capital Costs for Solid Waste Disposal

The 1970 capital costs for solid waste disposal projects are $39,031,800, including engineering and contingencies. This is the estimate for Plan "A", which includes disposal needs for the entire County and the surplus material generated by the Southeastern Oakland County Incinerator Authority.

Plan "B" costs, which do not include the Authority, are $31,455,400 and also include engineering and contingencies.

Plan "A" would obligate Oakland County by only 1.13% of the 1968 equalized valuation and Plan "B" by only 0.91%. Both amounts are well within the outside debt limitation of 10% including the remainder of the County supported debt.

With further growth of the equalized value of Oakland County by 1970 the valuation is expected to be up another 20% and the debt attributable to solid waste disposal at that time is expected to be only 0.94% for Plan "A" and 0.76% for Plan "B".

The additional expenditure in 1980 for Plan "A" is estimated to be $17,919,900 and for Plan "B", $20,238,900. The estimated increase in equalized valuation is 58.4% between 1970 and 1980 and the additional debt to be assumed for solid waste disposal in 1980 would be 0.0027% of the then equalized value for Plan "A" and 0.0031% for Plan "B".

Oakland County has the capacity and will have the capacity to finance the entire program of solid waste disposal for the capital improvement expense for both 1970 and 1980. The municipalities which will benefit from the program will pay for the capital improvement costs through the various charges they are permitted to make and also the yearly operational costs. The capital cost obligation assumed by the County is not significant in proportion to the permitted general obligation debt limitation.

CONVENIENCE CENTERS CAPITAL COSTS

OAKLAND COUNTY

Township	No. of Stations	Capital Costs each 1970	Equalized Valuation 1968	Tax rate per $1000 to amortize Capital Costs 10 yrs.	15 yrs.	20 yrs.
Addison	2	$100,900	$16,682,302	$0.77	$0.57	$0.48
Brandon	3	141,400	25,904,860	0.70	0.52	0.43
Groveland	4	114,800	15,890,350	0.92	0.69	0.57
Highland	3	145,200	45,079,800	0.41	0.31	0.26
Holly	2	109,500	40,041,300	0.35	0.26	0.22
Independence	3	146,500	84,150,100	0.22	0.17	0.14
Lyon	2	107,900	30,433,600	0.45	0.34	0.28
Milford	2	111,000	49,472,200	0.29	0.21	0.18
Oakland	3	87,500	46,070,000	0.24	0.18	0.15
Orion	3	148,600	76,660,540	0.25	0.18	0.15
Oxford	3	148,600	41,437,600	0.46	0.34	0.28
Rose	3	83,700	16,042,260	0.66	0.50	0.41
Springfield	4	94,800	24,588,000	0.49	0.37	0.31
Novi	2	108,000	74,016,400	0.19	0.14	0.12
Total	39	$1,648,400	$586,479,312	(0.365)	(0.267)	(0.223) Average

Operational Financing

While the capital and operational costs will be assumed by the local governments from various charges, a county at-large tax could be levied to pay for the service. This is not suggested as a solution, but noted here to show that it is possible.

Were Plan "A" to be paid for at-large on the basis of the 1968 equalized value, the yearly charge would be $2.67 per thousand. On the basis of the projected valuation for 1970 the cost per thousand of equalized value would be $2.23 per year for all of the service described here, including the residue from the South Eastern Oakland County Incinerator Authority.

For Plan "B", which does not include the Authority, the equalized valuations of the Authority members have been deducted and the cost to the remainder of the County would be $3.05 based on the 1968 valuation. On the projected valuation for 1970 the tax rate necessary to support the service would be $2.63 per thousand.

Under Act 342 each individual community could levy these tax rates above any limitation and in turn pay the County for the service.

Convenience Centers

There are 39 Convenience Centers recommended for 14 of the Townships which could be constructed in 1970 if the County were to be fully covered to give proper service. An additional 2 convenience centers are recommended by 1980. On the basis of the 1968 equalized valuation the yearly cost of operation and amortization of capital costs would be 49 cents per thousand. On the basis of the projected 1970 equalized valuation the cost would be 41 cents per thousand. All tax rates projected are based on the total County valuation assuming the responsibility for the Convenience Centers. This is a reasonable cost to assure the construction and operation of this type of facility.

The cost of construction and operation could also be assumed by the County and built-in to the rate charged the municipalities for the entire service.

There is another possible means to solve the problem of solid wastes in sparsely settled areas from the financial standpoint. This could involve the local units paying for the cost of construction of the Convenience Centers within their borders and then spreading the cost of operation of the Centers as well as the whole service to the participating municipalities.

Each Township Board involved could contract with the County Agency assigned the task by the Board of Supervisors, and by resolution assume the capital costs and interest payments for the construction costs.

Because of the Township payment of capital costs the rate for disposal and annual costs as compared to those stated elsewhere in this Report would be slightly lower. No attempt has been made to amortize the capital cost additions by 1980. The valuations for each individual unit will increase, but no attempt has been made here to project this increase, except on a County-wide basis.

Shown in the Table on the opposite page are the Townships in which the Convenience Centers will be located, the number recommended by 1970, the capital costs for each Township, the equalized value, and the tax rate (based on the 1968 valuation) necessary to pay for the capital costs of the convenience centers for each year for individual Townships. A 10, 15, and 20 year amortization is included. However, it would be understood that the County would have to settle on only one as the bonds will be sold for a specified number of years.

Another test has been made of the impact on the tax rate for the above Townships if the capital cost amortization and annual costs of operation were included. They ran from $1.39 per thousand each year to $8.38 per thousand, and would seem impractical.

Serious consideration should be given to piecing together a combination of the above financial facts to suit all of the County governmental units and include Convenience Centers as an integral part of any over-all solution.

PUBLIC RELATIONS AND SOLID WASTE DISPOSAL

The general public does not like to think of refuse disposal. They recognize it as an essential service but are unwilling to agree to location of facilities near their homes. Often separation of several miles is insufficient to gain acceptance of a refuse disposal site.

The program proposed in this Report will locate several disposal sites throughout the County. Seven townships will contain a site. Additional municipalities will be on the route taken by vehicles transporting refuse or residue from one location to another. This diversification of sites for the program will create a large public outcry against the County Plan unless something is done to relieve the anxieties of the public.

A sound public relations program will be an efficient tool in winning the acceptance required to implement your program. Models, pictures, charts and drawings are a part of the public relations effort. They help explain the need and the effect of the program. These visual aids, however, do not allay the fears of persons not thoroughly informed of the problem and its solution. It is the most difficult part of the public relations program dealing with the human elements of the problem that we discuss in greater detail.

No other public service is so closely associated with the individual citizen as refuse disposal and he therefore feels compelled to voice his opinions regarding any change of service. These opinions are usually heard as objections by public officials, and the strength of these objections varies with a person's habits, personality and philosophy of life.

Motivating the Public

The major motivating forces in the resistance to change in the solid waste service of the community are cost, security, health, safety, and social recognition.

Effective solid waste management costs money. Unfortunately, the cost is too large to be easily overlooked, but is not beyond the comprehension of the average person. Usually the resident wants to know how much of the cost of a project will come from his own pocket and how much the "government" is going to "give" him or his community. It is frequently difficult to obtain acceptance of a worthy project even when an economic benefit can be shown. Other motivations become dominant in this case.

Two such motivations – security, and health and safety – perhaps cause more apprehension for the local citizenry than any other except cost. The resident of an area holds a possessive attitude toward his home, his land, his roads, and as we have earlier pointed out, his lakes. The resident wants to know what effect the hauling of refuse will have on his streets, his traffic habits, and the safety of his children and his neighbor's children. He inquires about the safety and the effect on his health, and he ponders unforeseen problems which might arise because of the new disposal method. The local citizen is entitled to know to the best of technical knowledge what effects the location of facilities in his area will have upon his life and his property. Usually, the well-informed citizen will become an ally and will be able to help in the realization of a project, since his knowledge helps dispel the fears of his neighbors.

The final motivation which we will discuss is social recognition. This force often causes the undecided citizen to raise his voice in protest. Such a person is reluctant to face the problem for himself and to reach his own decisions out of fear of what his neighbors will think. Although people with this attitude will swell the ranks of any public hearing, such opposition subsides rapidly after a decision has been reached.

Gaining Public Acceptance

Locating technically suitable solid waste disposal sites is in itself difficult. Finding a site totally acceptable to the local population is almost impossible. Many political jurisdictions in Oakland County have no suitable space for disposal facilities and must rely upon their neighbors to accept waste from their community. Under the section of this Report entitled

"Historical Considerations" we point out that 32 county communities haul refuse to another community while an additional 25, although it is not specifically stated, probably do so also.

The concept of solid waste disposal as a regional problem escapes the ordinary household. The primary concerns are for the speed with which refuse is taken from the property and located elsewhere and the neatness of the service rendered. Therefore, the larger objectives of air pollution abatement, of the creation of parks and recreation facilities, of land reclamation and creation of open space all at some indefinite time in the future should take a secondary place to the personal interest of the household. The homeowner is more interested in increased property values, the clean-up of the roadside trash pile his child plays on, and the removal of abandoned automobile hulks in the vacant lot across the street than he is in the future welfare of his community. He frequently views such facilities as golf courses, park land, and general recreational facilities as a benefit to the affluent few rather than as a direct benefit to himself.

The public inertia against the location of facilities in a given neighborhood can be overcome by a well-organized approach to the people. You will find it difficult to convince the opposition and to win friends for your cause, because health is an abstract subject and garbage ranks low as a conversational topic. The way to gain acceptance is through a good public relations program.

Public Relations Program

Local news media can be helpful in presenting your program to the people. Newspapers, radio, and television often look for a crusade which will be a public service to their customers and which can help increase their circulation or listening audience. News releases, interviews with reporters, and field trips to pick out and show the local trouble spots help these sources to help you. The news media can do much of the ground work to convince the general public of the worthiness of your proposed sites and methods of operation if they become interested in your project. Officials should make every effort to contact local citizens to explain the proposed operation. Public meetings help present a project to the public.

Some persons in a community may be difficult to convince. They continue to object despite these efforts to convince them that the program is worthwhile and should be implemented. In such cases, personal contact by a responsible official of the agency in charge of the project is appropriate. Such personal interest in the problems of a citizen can often pave the way for cooperation. The public relations program should extend to a field trip to local as well as competently operated distant sites, with a group of opponents to the project. Viewing a well-run refuse disposal operation, and explaining ways to avoid the problems of concern to the group, can do more to convince strong objectors than hours of talk and hundreds of pictures. The expense of such a trip will be returned in public understanding of your problems and cooperation with your program. If influential opponents to your program are chosen the return will be even greater because they will tell their neighbors and friends of what they have seen and learned on the trip. Effective communication with dissenters reduces the opposition to a project.

Residents whose property is near a proposed site will be the most difficult to convince. No one wants a refuse disposal facility in his backyard, but the County is too densely developed to isolate these facilities from everyone. When all factors have been considered and a decision made on the location of the disposal area, every effort should be exerted to convince the surrounding people that their interests are not being jeopardized, and that the decision is the correct one. It is important not to change the decision once made. Once a change is made, citizens living near any other proposed site will exert all possible pressure to produce another change.

Inducements

Certain inducements can be offered to help convince surrounding property owners that the location of the disposal site in their neighborhood is not a detriment. Better roads can be cited as improvements arising because of the disposal facility; utility extension to nearby properties may be feasible, particularly where incinerators are to be built. Local disposal sites can be properly closed by the County Agency. The County, in general, can make payments to the local government to make up for the taxes lost when land formerly in private hands is converted to public property. Additional payments might be made by the County to local subdivisions to help reimburse for nuisances and maintenance arising from refuse traffic on local roads, or lower disposal rates may be enacted for local residents. Such funds should be used by the local subdivision primarily in the neighborhood immediately adjacent to the disposal facility. Sites which have been expended, such as ash disposal facilities, or sanitary landfills where the land is not leased by the County, can be returned to the local political authority for use by its citizenry.

Recommendation

We recommend that a public relations program be an integral part of your program of solid waste planning and management.

APPENDIX

TABLE I

POPULATION PROJECTION

SUBDIVISION			YEAR		
	1970	1975	1980	1985	1990
CITIES					
Berkley	27,000	27,000	27,000	27,000	27,000
Birmingham	32,900	32,900	32,900	32,900	32,900
Clawson	21,000	21,000	21,000	21,000	21,000
Ferndale	38,000	38,000	38,000	38,000	38,000
Hazel Park	32,000	32,000	32,000	32,000	32,000
Huntington Woods	9,100	9,100	9,100	9,100	9,100
Keego Harbor	3,000	3,000	3,000	3,000	3,000
Lathrup Village	4,500	4,500	4,500	4,500	4,500
Madison Heights	59,000	59,000	59,000	59,000	59,000
Oak Park & Royal Oak Township	55,200	55,200	55,200	55,200	55,200
Pleasant Ridge	3,800	3,800	3,800	3,800	3,800
Pontiac	96,000	96,000	96,000	96,000	96,000
Rochester	6,500	6,900	7,500	7,800	8,000
Royal Oak	110,000	110,000	110,000	110,000	110,000
Southfield	57,400	105,000	126,500	126,500	126,500
Sylvan Lake	2,400	2,400	2,400	2,400	2,400
Troy	34,000	42,000	49,000	54,000	57,000
Walled Lake	4,200	4,200	4,200	4,200	4,200
Wixom	3,000	7,500	9,200	9,200	9,200
VILLAGES					
Beverly Hills	12,000	12,000	12,000	12,000	12,000
Bingham Farms & Franklin	4,000	4,800	6,000	7,800	10,000
Lake Angelus	300	300	300	300	300
Novi & Northville	8,500	11,200	14,900	19,700	21,400
Quakertown & Wood Creek Farms	2,000	2,400	3,000	3,600	4,000
Wolverine Lake	3,100	3,100	3,100	3,100	3,100
TOWNSHIPS					
Addison & Leonard Village	2,200	2,500	2,900	4,500	5,100
Avon	29,600	36,500	40,500	43,000	45,000
Bloomfield & Bloomfield Hills	39,750	44,400	53,000	81,000	124,000
Brandon & Ortonville	3,780	3,800	3,980	4,300	4,580
Commerce	13,400	30,400	45,400	47,000	48,400
Farmington & City of Farmington	42,950	51,000	61,000	95,000	142,000
Groveland	1,530	1,600	1,730	1,900	2,230
Highland	6,800	7,700	9,000	12,000	16,400
Holly & Holly Village	6,400	6,550	6,700	6,900	7,200
Independence & Clarkston	14,500	15,500	17,300	27,000	41,800
Lyon & South Lyon City	5,870	6,300	6,870	7,800	9,800
Milford & Milford Village	6,930	7,400	7,930	9,000	11,000
Oakland	3,600	4,100	4,700	5,700	8,200
Orion & Lake Orion Village	14,900	16,000	17,800	28,000	42,200
Oxford & Oxford Village	6,690	6,800	6,990	7,200	7,490
Pontiac	15,000	30,000	45,700	60,000	74,700
Rose	1,900	2,000	2,100	2,300	2,600
Springfield	3,100	3,200	3,300	3,500	3,800
Waterford	61,000	81,000	105,000	125,000	140,000
West Bloomfield & Orchard Lake	21,600	42,000	53,600	55,000	56,600
White Lake	11,600	13,500	16,200	20,000	26,700
Total	942,000	1,105,550	1,241,300	1,383,200	1,569,400

TABLE II

COMMERCIAL FLOOR AREA
(SQ. FT.)

SUBDIVISION	YEAR 1970	1975	1980	1985	1990
CITIES					
Berkley	1,238,100	1,296,500	1,354,900	1,413,300	1,471,700
Birmingham	2,918,400	3,056,100	3,193,700	3,331,400	3,469,000
Clawson	719,500	753,500	787,400	821,300	855,300
Ferndale	2,840,100	2,974,000	3,108,000	3,242,000	3,376,000
Hazel Park	1,870,500	1,958,700	2,047,000	2,134,800	2,223,000
Huntington Woods	234,100	244,900	256,100	267,100	278,200
Keego Harbor	228,500	239,300	250,100	260,900	271,700
Lathrup Village	161,200	177,200	185.100	193,100	201,100
Madison Heights	2,335,200	2,445,400	2,555,600	2,665,800	2,775,900
Oak Park & Royal Oak Township	4,981,600	5,216,600	5,421,500	5,686,500	5,922,500
Pleasant Ridge	174,100	182,300	190,500	198,700	206,900
Pontiac	21,890,700	24,058,500	26,226,300	28,394,100	30,561,900
Rochester	774,200	1,016,200	1,258,100	1,500,100	1,742,000
Royal Oak	8,158,500	8,966,200	9,773,900	10,581,600	11,389,300
Southfield	8,100,400	9,887,300	11,674,200	13,461,100	15,248,000
Sylvan Lake	373,900	391,500	409,100	426,700	444,300
Troy	11,357,500	12,801,300	14,245,100	15,688,900	17,132,700
Walled Lake	692,800	725,500	758,200	790,900	823,600
Wixom	283,500	372,100	460,700	549,300	637,900
VILLAGES					
Beverly Hills	1,100,100	1,152,000	1,203,900	1,255,800	1,307,700
Bingham Farms & Franklin	277,000	348,600	420,200	491,800	563,400
Lake Angelus	1,700	1,900	2,100	2,300	2,500
Novi & Northville	1,038,500	1,307,100	1,575,700	1,844,300	2,112,900
Quakertown & Wood Creek Farms	4,700	5,600	6,500	7,400	8,300
Wolverine Lake	58,200	60,900	63,600	66,300	69,000
TOWNSHIPS					
Addison & Leonard Village	160,100	197,600	235,100	272,600	310,100
Avon	1,892,000	2,132,500	2,373,000	2,613,500	2,854,000
Bloomfield & Bloomfield Hills	2,723,800	2,851,300	2,978,800	3,106,300	3,233,800
Brandon & Ortonville	275,200	288,200	301,200	314,200	327,200
Commerce	1,119,000	1,468,700	1,818,400	2,168,100	2,517,800
Farmington & City of Farmington	7,821,800	10,266,100	12,710,400	5,154,700	17,599,000
Groveland	1,198,600	1,305,600	1,412,600	1,519,600	1,626,600
Highland	541,400	674,900	708,400	841,900	975,400
Holly & Holly Village	708,400	741,800	775,200	808,600	842,000
Independence & Clarkston	850,700	1,099,300	1,347,900	1,596,500	1,845,100
Lyon & South Lyon City	606,300	683,400	760,500	837,600	914,700
Milford & Milford Village	960,000	1,082,100	1,204,100	1,326,200	1,448,300
Oakland	183,400	191,800	200,200	208,600	217,000
Orion & Lake Orion Village	1,844,800	2,383,800	2,922,800	3,461,800	4,000,800
Oxford & Oxford Village	684,300	835,300	986,300	1,137,300	1,288,300
Pontiac	1,831,200	8,698,200	15,565,200	22,432,200	29,299,200
Rose	--	--	--	--	--
Springfield	615,400	679,300	1,033,200	1,097,100	1,196,000
Waterford	5,103,700	6,295,800	7,487,900	8,680,000	9,872,100
West Bloomfield & Orchard Lake	1,595,000	2,026,100	2,457,200	2,888,300	3,319,400
White Lake	5,898,600	7,252,700	8,606,800	10,960,900	12,315,000

TABLE III
METHODS AND COSTS OF COLLECTION AND DISPOSAL OF REFUSE IN OAKLAND COUNTY

MUNICIPALITY & POPULATION	COLLECTION METHODS AND AMOUNTS COLLECTED			EQUIPMENT AND CREW			COLLECTION COST		DISPOSAL METHODS			FUTURE LIFE OF SITES	HOW FINANCED
	GARBAGE	RUBBISH	COMBINED	GARBAGE	RUBBISH	COMBINED	RESIDENTIAL	COMMERCIAL	GARBAGE	RUBBISH	COMBINED		
Berkley City 23,700			Municipal forces R - 1/wk C - 3/wk			4 comp. trk., 3 men each; 2 open trk., 2 men	$127,000 (1965)				Incinerator (SEOCIA)		General Fund
Birmingham City 26,600			Contract R - 2/wk summer R - 1/wk winter Municipal forces C- 1 to 5/wk 10,630 tons (1965)			6 comp. trk., 2 men each 2 dump trk., 2 men each	$120,603 (1965)				Incinerator (SEOCIA) $48,430 (1965) and open dump		General Fund
Bloomfield Hills City 2,378	Private hauler	Private hauler					By arrangement					Unknown	Service charge
Clawson City 17,700			Municipal forces R - 1/wk C - 3/wk 6,766 tons (1965) (75%)			3 comp. trk., 3 men each 1 dump trk.	$62,700 (1965)				Incinerator (SEOCIA) $30,500 (1965)		General Fund
Farmington City 10,000			Contract R - 1/wk C - 2/wk 52,600 cu. yds.		3 open trk., 3 men each	2 comp. trk., 3 men each	$36,100 (1965)				San. L.F. in Novi, Mich.	2	General Fund
Ferndale City 31,500			Municipal forces R - 1/wk C - By arrangement 12,655 tons (1961)			7 comp. trk., 3 men each; 2 dump trk., 2 men	$172,100 (1965)				Incinerator (SEOCIA) $74,180 (1965)		General Fund

TABLE III
(continued

MUNICIPALITY & POPULATION	COLLECTION METHODS AND AMOUNTS COLLECTED			EQUIPMENT AND CREW			COLLECTION COST		DISPOSAL METHODS			FUTURE LIFE OF SITES	HOW FINANCED
	GARBAGE	RUBBISH	COMBINED	GARBAGE	RUBBISH	COMBINED	RESIDENTIAL	COMMERCIAL	GARBAGE	RUBBISH	COMBINED		
Hazel Park City 26,000			Municipal forces R - 1/wk C - 1 to 5/wk 10,629 tons (1965)			5 comp. trk., 2 men each; 2 dump truck, as reqd.	$95,215 (1965)				Incinerator (SEOCIA) $51,900 (1965)		General Fund
Huntington Woods City 9,500			Municipal forces R - 1/wk C - 2/wk 3,500 tons (1965)			3 comp. trk., 3 men each; 1 dump trk., 2 men	$38,515 (1965)				Incinerator (SEOCIA) $19,900 (1965)		General Fund
Keego Harbor City 2,000	Contract R - 1/wk C - 2/wk	Municipal forces R - 1/mo.	Contract			Unknown	$13.00 per/yr. per/res. (includes disposal)	By Arrangement			San. L.F.	Unknown	General Fund
Lathrop Village 4,000			Contract R - 1/wk C - 1/wk 1390 tons (1965)			3 comp. trk., 2 men each; 1 dump trk., 2 men	$10,000 (1965)				Incinerator (SEOCIA) $7,200 (1965)		General Fund
Madison Heights City 40,000			Contract R - 1/wk C - 1/wk			Unknown	$91,000 (1965)				Incinerator (SEOCIA) $62,000 (1965)		General Fund
Oak Park City 39,000			Contract R - 1/wk C - 1-3/wk 13,972 tons (1965)			5 comp. trks., 3 men each 1 Open body trk.	$103,789 (1965)				Incinerator (SEOCIA) $70,590 (1965)		General Fund

TABLE III
(continued)

MUNICIPALITY & POPULATION	COLLECTION METHODS AND AMOUNTS COLLECTED			EQUIPMENT AND CREW			COLLECTION COST		DISPOSAL METHODS			FUTURE LIFE OF SITES	HOW FINANCED
	GARBAGE	RUBBISH	COMBINED	GARBAGE	RUBBISH	COMBINED	RESIDENTIAL	COMMERCIAL	GARBAGE	RUBBISH	COMBINED		
Pleasant Ridge City 4,000											Incinerator (SEOCIA)		
Pontiac City 86,000	Municipal forces C - 1-5/wk (80%) Private hauler C - 2/wk (20%)	Private hauler C - 100%	Municipal forces R - 1/wk (99%) Private hauler R - 1/wk (1%)	2 comp. trk. 1 man each		7 comp. trk., 3 men each 1 dump trk., 1 man 1 Open trk., 1 man	$307,002 (1965) (city forces only)				San. L.F. 2 mi. W. of City	1½ years	Special Millage
Royal Oak City 90,000 est.			Municipal forces R - 1/wk C - 5/wk 37,035 tons (1961)			14 comp. trk., 3 men each 1 dump trk., 1 man 1 Open Body trk., 2 men	$466,580 (1965)				Incinerator (SEOCIA) $182,332 (1965)		General Fund and Special Millage
Southfield City 60,500			Contract R - 1/wk Private hauler; C - By arrangement			4 comp. trk.	$102,454 (1965) (includes disposal uy contractor)					Unknown	Service Charges
South Lyon City 1,765			Contract R - 1/wk C - 2/wk			Unknown	Unknown				Unknown	Unknown	Unknown

TABLE III
(continued)

MUNICIPALITY & POPULATION	COLLECTION METHODS AND AMOUNTS COLLECTED			EQUIPMENT AND CREW			COLLECTION COST		DISPOSAL METHODS			FUTURE LIFE OF SITES	HOW FINANCED
	GARBAGE	RUBBISH	COMBINED	GARBAGE	RUBBISH	COMBINED	RESIDENTIAL	COMMERCIAL	GARBAGE	RUBBISH	COMBINED		
Sylvan Lake City 2,004	Contract R - 2/wk summer R - 1/wk winter 360 cu.yds. (1961)	Municipal forces R - 1/mo. 890 cu. yds. (1961)		Comp. trk., 1-2 men	1 dump trk., 2 men		$8,701 (includes disposal by contractor)				San. L.F. in City of Pontiac $1/cu. yd.	Unknown	Special Millage
Troy City 25,500 est.			Contract R - 1/wk C - 1/wk 4,703 tons			2 comp. trk., 3 men each	$15.00 per/mo. per/res.	$25.00 per/mo. per/ establishment			Incinerator (SEOCIA) $26,306 (1966)		Service Charge
Walled Lake City 4,270			Contract R - 1/wk C - 1/wk			Unknown	$15,000 (1961) (includes disposal)				San. L.F.	Unknown	General Fund
Wixom City 1,800			Contract R - 1/wk C - 1/wk			1 comp. trk., 2 men	$5,100 (1966) (includes disposal)						General Fund
Beverly Hills Village 12,000			Contract R - 2/wk C - by arrangement 4,800 tons (1961)		2 comp. trk., 3 men		$37,000 (1966)				Incinerator (SEOCIA)		General Fund
Bingham Farms Village 394		Contract R - 1/mo.			Unknown		Unknown			Unknown		Unknown	General Fund

TABLE III
(continued)

MUNICIPALITY & POPULATION	COLLECTION METHODS AND AMOUNTS COLLECTED			EQUIPMENT AND CREW			COLLECTION COST		DISPOSAL METHODS			FUTURE LIFE OF SITES	HOW FINANCED
	GARBAGE	RUBBISH	COMBINED	GARBAGE	RUBBISH	COMBINED	RESIDENTIAL	COMMERCIAL	GARBAGE	RUBBISH	COMBINED		
Clarkston Village 1,200			Private hauler R - 2/wk summer R - 1/wk winter C - 3/wk			Unknown	$25.00 per/yr. per/res.	$25.00 per/mo. per establishment			San. L.F.		Service Charge
Franklin Village 3,000		Contract R - 1/mo.			1 comp. trk.		$230 per/mo. (includes disposal) (1965)			Open dump 8 mi. N.W. in Waterford Twp.		Unknown	General Fund
Holly Village 3,500 est.	Contract R - 1/wk C - By arrangement	Municipal R - 1/wk		2 comp. trk.	2 dump trk., 2 men each	2 comp. trk., 3 men each	$9,700 (1965) (includes disposal)				San. L.F.	25-50 yr.	General Fund
Lake Angelus Village 125			Private hauler R - 1/wk			Unknown	$4.50 per/mo. per/res.				Unknown		Service Charge
Lake Orion Village 2,750			Contract R - 2/wk summer R - 1/wk winter				$3,000 (1965) (includes disposal)						General Fund
Leonard Village 360			Contract R - 1/wk C - 2/wk 600 cu. yd.			3 comp. trk., 2 men each	$2.50 per/mo. per/stop (1965) (includes disposal)				San. L.F.	Unknown	Service Charge
Milford Village 6,000			Contract R - 1/wk C - 1/wk				$10,000 (1965) (includes disposal)						General Fund

TABLE III
(continued)

MUNICIPALITY & POPULATION	COLLECTION METHODS AND AMOUNTS COLLECTED			EQUIPMENT AND CREW			COLLECTION COST		DISPOSAL METHODS			FUTURE LIFE OF SITES	HOW FINANCED
	GARBAGE	RUBBISH	COMBINED	GARBAGE	RUBBISH	COMBINED	RESIDENTIAL	COMMERCIAL	GARBAGE	RUBBISH	COMBINED		
Novi Village 7,500			Private Hauler									Unknown	Service Charge
Orchard Lake Village 1,250			Municipal forces R - 1/wk C - 1/wk 1,300 cu. yd. (1965)			1 comp. trk. 2 man crew	$8,000 (1966)				San. L.F. City of Pontiac	Unknown	General Fund
Ortonville Village 771			Private hauler										Service Charge
Oxford Village 2,357			Contract R - 2/wk summer R - 1/wk winter C - as required				$7,930 (1966) (includes disposal)						Service Charges
Quakertown Village 462	No	Collection											

TABLE III
(continued)

MUNICIPALITY & POPULATION	COLLECTION METHODS AND AMOUNTS COLLECTED			EQUIPMENT AND CREW			COLLECTION COST		DISPOSAL METHODS			FUTURE LIFE OF SITES	HOW FINANCED
	GARBAGE	RUBBISH	COMBINED	GARBAGE	RUBBISH	COMBINED	RESIDENTIAL	COMMERCIAL	GARBAGE	RUBBISH	COMBINED		
Rochester Village 5,431			Contract R - 1/wk			2 comp. trk.	$24,719 (1980)						General Fund
Wolverine Lake Village 2,404			Contract				$1004/mo.						
Wood Creek Farms Village 850 est.			Contract R - 1/mo Private hauler By ar- rangement			Comp. trk.	$960. per/yr.	By arrangement					General Fund
Addison Township 1,400			Private hauler R - 1/wk (85%) C - 2/wk (800 cu.yd.)			3 comp. trk. 2 men each	$2.50 per/mo. per/res.	$2.50 per/mo. per/est.			San. L.F.		Service Charge
Avon Township 18,000			Private hauler By ar- rangement				By arrangement (includes disposal)				San. L.F. E. side of Twp.	10 yr.	Service Charge
Bloomfield Twp. 22,530	The no	Township has collection system											

TABLE III
(continued)

MUNICIPALITY & POPULATION	COLLECTION METHODS AND AMOUNTS COLLECTED			EQUIPMENT AND CREW			COLLECTION COST		DISPOSAL METHODS			FUTURE LIFE OF SITES	HOW FINANCED
	GARBAGE	RUBBISH	COMBINED	GARBAGE	RUBBISH	COMBINED	RESIDENTIAL	COMMERCIAL	GARBAGE	RUBBISH	COMBINED		
Brandon Twp. 3,600			Contract R - 2/wk summer R - 1/wk winter C - 2/wk summer C - 1/wk winter				$2.50/mo. per/res.	$2.50/mo. per/establishment			San. L.F. with Groveland & Independence	7 yr.	Service Charge
Commerce Twp. 14,000 (1966)			Private hauler R - 1/wk C - 1/wk				$2.25/mo. rubbish $2.00/mo. garbage $1.75/mo. disposal				San. L.F. in White Lake Twp.	Unknown	Service Charge
Farmington Twp. 32,000	Private Hauler R.	Contract R - 100%	Private hauler C as arranged		2 comp. trk.		$12,000 (1965) (includes disposal)	By Arrange		San. L.F.		10 yrs.	General Fund
Groveland Twp. 1,600		Private hauler R - (Serves 20%)					By Arrangement			San. L.F. in Brandon Twp.		Unknown	Service Charge
Highland Twp. 5,700			Private hauler				$3.00/mo. per/res. (includes disposal)				San. L.F.		Service Charge
Holly Township 3,200			Private Hauler R- (serves 20%)				Unknown	Unknown			San. L.F. N.E. of Twp.		
Independence Twp. 10,121	No	information											
Lyon Township 8,000			Private Hauler R - By arrangement C - By arrangement 80 cu. yd.			Unknown	Unknown	Unknown			Open dump center of Township	2 - 4 yr.	Service Charge

TABLE III
(continued)

MUNICIPALITY & POPULATION	COLLECTION METHODS AND AMOUNTS COLLECTED			EQUIPMENT AND CREW			COLLECTION COST		DISPOSAL METHODS			FUTURE LIFE OF SITES	HOW FINANCED
	GARBAGE	RUBBISH	COMBINED	GARBAGE	RUBBISH	COMBINED	RESIDENTIAL	COMMERCIAL	GARBAGE	RUBBISH	COMBINED		
Milford Township 1,548	The no	Township has collection system									Open dump 1 mi. N. in Highland Twp.		
Oakland Township 2,469			Private hauler				$2.00 per/mo. per/res.				Open dump Orion Twp. $1,200 (1965)	Unknown	General Fund and Service Charge
Orion Township 13,000			Contract R -(service 80%) C -(service 100%)								San. L.F. Orion-Pontiac Twp. Land-fill Authority	10 yr.	Service Charge
Oxford Township 3,500 est.			Contract R - 2/wk summer R - 1/wk winter Private hauler (18304 cu. yd.			3 Comp Trucks 2 men each 2 Dump Trucks 1 man	$1800 (1965)				Township pays $75 per mo. to Orion Twp. for use of disposal site	Unknown	$2.00 per/mo. per/res.
Pontiac Township 12,000			Private hauler R - 1/wk C - 1/wk								Orion-Pontiac Twp. Landfill Authority $500 per/yr.	Unknown	Unknown
Rose Township			Private hauler				By Arrangement				Open dump S.E. cor. of Twp. $1000 (1965)	9 Mo.	Unknown

TABLE III
(continued)

MUNICIPALITY & POPULATION	COLLECTION METHODS AND AMOUNTS COLLECTED			EQUIPMENT AND CREW			COLLECTION COST		DISPOSAL METHODS			FUTURE LIFE OF SITES	HOW FINANCED
	GARBAGE	RUBBISH	COMBINED	GARBAGE	RUBBISH	COMBINED	RESIDENTIAL	COMMERCIAL	GARBAGE	RUBBISH	COMBINED		
Royal Oak Township 7,500			Municipal forces R - 1/wk C - 1-4/wk (1966)			1 comp. trk.	$14,251 (1961)				Incinerator (SEOCIA) $2,631 (1961)		General Fund Service Charges
Springfield Township 2,664	The no	Township has collection system							The no	Township has disposal site			
Waterford Township 47,008			Private hauler			Comp. trks.	By Arrangement				Open dump	Unknown	Service Charge
West Bloomfield Township 13,867			Private hauler (service 70%)				Unknown				Open dump	5 yr.	Service Charge
White Lake Township 12,000			Private hauler				$2.00 per/mo. per/res.	Unknown			San. L.F. in S. end of Twp.		Service Charge

TABLE IV

METHODS AND COSTS OF COLLECTION AND DISPOSAL OF REFUSE IN OAKLAND COUNTY EXCERPT FROM TABLE III - REFUSE DISPOSAL PLAN FOR THE DETROIT REGION

MUNICIPALITY & POPULATION	COLLECTION METHODS AND AMOUNTS COLLECTED			EQUIPMENT AND CREW			COLLECTION COST		DISPOSAL METHODS			FUTURE LIFE OF SITES	HOW FINANCED
	GARBAGE	RUBBISH	COMBINED	GARBAGE	RUBBISH	COMBINED	RESIDENTIAL	COMMERCIAL	GARBAGE	RUBBISH	COMBINED		
Berkley City 23,275			Municipal forces R - 1/wk C - 1 to 5/wk 8,326 tons (1961)			4 comp. trk., 3 men each; 1 dump trk., 2 men; 1 open trk., 2 men	$105,000 (1961)				Incinerator (SEOCIA) $39,513 (1961)		General Fund
Birmingham City 25,525			Contract R - 2/wk summer R - 1/wk winter C - 1 to 5/wk 8,519 tons (1961)			4 comp. trk., 2 men each	$88,701 (1961)				Incinerator (SEOCIA) $41,244 (1961)		General Fund and Service Charge
Bloomfield Hills City 2,378		Private hauler			1 comp. trk.		By arrangement			Open dump 5 mi N.E. in Avon Twp.		Unknown	Service Charge
Clawson City 14,795			Municipal forces R - 1/wk C - 3/wk 4,650 tons (1961)			3 comp. trk., 3 men each	$66,792 (1961)				Incinerator (SEOCIA) $21,661 (1961)		General Fund
Farmington City 6,881			Contract R - 1/wk C - 2/wk			2 comp. trk., 3 men each	$24,000 (1961)				Open dump 8 mi N.W. of City	Unknown	General Fund
Ferndale City 31,347			Municipal forces R - 1/wk C - By arrangement 12,655 tons (1961)			6 comp. trk., 3 men each; 1 dump trk 2 men; 1 pick-up trk., 2 men	$123,682 (1961)				Incinerator (SEOCIA) $42,930 (1961)		General Fund

TABLE IV
(continued)

MUNICIPALITY & POPULATION	COLLECTION METHODS AND AMOUNTS COLLECTED			EQUIPMENT AND CREW			COLLECTION COST		DISPOSAL METHODS			FUTURE LIFE OF SITES	HOW FINANCED
	GARBAGE	RUBBISH	COMBINED	GARBAGE	RUBBISH	COMBINED	RESIDENTIAL	COMMERCIAL	GARBAGE	RUBBISH	COMBINED		
Hazel Park City 25,631			Municipal forces R - 1/wk C - 1 to 5/wk 8,728 tons (1961)			4 comp. trk., 2 men each; 2 dump trk., 2 men each	$66,937 (1961)				Incinerator (SEOCIA) $42,930 (1961)		General Fund
Huntington Woods City 8,746			Municipal forces R - 1/wk C - 2/wk 3,176 tons (1961)			2 comp. trk., 3 men each; 1 dump trk. 2 men	$48,125 (1961)				Incinerator (SEOCIA) $14,921 (1961)		General Fund
Keego Harbor City 2,761	Contract R - 1/wk C - 2/wk	Municipal forces R - 1/mo.		One pick-up trk.	One dump trk.		$1.50 per/mo. per/res. (includes disposal)	By arrangement	San. L.F. 11 mi. W. of City	Unknown		2 years	General Fund
Lathrup Village 3,556			Contract R - 2/mo Private hauler C - By arrangement (288 tons) (1961)			3 comp. trk., 2 men each; 1 dump trk. 2 men.	$8,638 (1961)				Incinerator (SEOCIA) $1,489 (1961)		General Fund
Madison Heights City 33,343			Contract R - 1/wk C - 1/wk 10,400 tons (1961)			3 comp. trk., 2 men each	$59,754 (1961)				Incinerator (SEOCIA) $45,000 (1961)		General Fund
Oak Park City 36,632			Contract R - 1/wk C - 1/wk 12,058 tons (1961)			5 comp. trks, 2 men each	$90,309 (1961)				Incinerator (SEOCIA) $60,390 (1961)		General Fund

TABLE IV
(continued)

MUNICIPALITY & POPULATION	COLLECTION METHODS AND AMOUNTS COLLECTED			EQUIPMENT AND CREW			COLLECTION COST		DISPOSAL METHODS			FUTURE LIFE OF SITES	HOW FINANCED
	GARBAGE	RUBBISH	COMBINED	GARBAGE	RUBBISH	COMBINED	RESIDENTIAL	COMMERCIAL	GARBAGE	RUBBISH	COMBINED		
Pleasant Ridge City 3,807			Municipal forces R - 1/wk C - 1/wk 1,560 tons (1961)			1 comp. trk., 3 men.	$10,114 (1961)				Incinerator (SEOCIA) $6,556 (1961)		General Fund
Pontiac City 82,233	Municipal forces R - 1/wk C - 2/wk (75%) Private hauler C - 2/wk (25%) 70,491 cu. yds. (1961)	Municipal forces R - 2/mo. Private hauler C - By arrangement 48,371 cu. yds. (1961) (res. only)		12 comp. trk., 3 men each	7 open trk., 2 men each; 2 pick-up trk.		$252,470 (1961) (city forces only)				San. L.F. 1 mi. W. of City	3 to 4 years	Special Millage
Royal Oak City 80,612			Municipal forces R - 1/wk C - 5/wk 30,122 tons (1961)			10 comp. trk.	$285,348 (1961)				Incinerator (SEOCIA) $134,394 (1961)		General Fund
Southfield City 31,531			Contract R - 1/wk, Private hauler; C - By arrangement			4 comp. trk.	$63,663 (1961) (includes disposal by contractor)					Unknown	General Fund
South Lyon City 1,753			Contract			2 comp. trk.	$1.00 per/mo. per/res.	By arrangement			Open dump 25 mi. N.W. in Howell Twp	Unknown	Service Charge

TABLE IV
(continued)

MUNICIPALITY & POPULATION	COLLECTION METHODS AND AMOUNTS COLLECTED			EQUIPMENT AND CREW			COLLECTION COST		DISPOSAL METHODS			FUTURE LIFE OF SITES	HOW FINANCED
	GARBAGE	RUBBISH	COMBINED	GARBAGE	RUBBISH	COMBINED	RESIDENTIAL	COMMERCIAL	GARBAGE	RUBBISH	COMBINED		
Sylvan Lake City 2,004	Contract R - 2/wk summer R - 1/wk winter 276 cu. yds. (1961)	Municipal forces R - 1/mo. 744 cu. yds. (1961)		Open trk.	1 dump trk., 2 men.		$6,861 (includes disposal by contractor)				San. L.F. in City of Pontiac	Unknown	Special Millage
Troy City 19,058			Contract R - 1/wk C - 1/wk 1,794 tons (1961)			Unknown	$4.00 per/mo. per/res.	$6.25 per/mo. per/establishment			Incinerator (SEOCIA; $8,832 (1961: Part Only)		General Fund
Walled Lake City 3,550			Contract R - 1/wk C - 1/wk			Unknown	$6,500 (1961) (includes disposal)				San. L.F. 7 mi. N.W. of City Open dump 2 mi. W. of City.	Unknown	General Fund
Wixom City 1,531			Contract R - 1/wk C - 1/wk			Unknown	$2,100 (1961) (includes disposal)				Open dump 2 mi. S. of City	Unknown	General Fund
Beverly Hills Village 8,633		Contract R - 2/mo. C - by arrangement 1,546 tons (1961)			1 comp. trk., 2 men		$15,271 (1961)				Incinerator (SEOCIA) $7,355 (1961)		General Fund
Bingham Farms Village 394		Contract R - 1/mo.			Unknown		Unknown			Unknown		Unknown	General Fund

TABLE IV
(continued)

MUNICIPALITY & POPULATION	COLLECTION METHODS AND AMOUNTS COLLECTED			EQUIPMENT AND CREW			COLLECTION COST		DISPOSAL METHODS			FUTURE LIFE OF SITES	HOW FINANCED
	GARBAGE	RUBBISH	COMBINED	GARBAGE	RUBBISH	COMBINED	RESIDENTIAL	COMMERCIAL	GARBAGE	RUBBISH	COMBINED		
Clarkston Village 769			Private hauler R - 2/wk summer R - 1/wk winter C - 3/wk			1 comp. trk., 2 dump trk.	$21.00 per/yr. per/res.	$10.00 per/mo. per establishment			San. L.F. N. edge of Village	10 years	Service Charge
Franklin Village 2,262		Contract R - 1/mo.			1 comp. trk.		$210 per/mo. (includes disposal)			Open dump 8 mi. N.W. in Waterford Twp.		Unknown	General Fund
Holly Village 3,296	Contract R - 1/wk C - By arrangement summer only)	Municipal R - 1/wk	Contract R - 1/wk C - By arrangement	2 comp. trk.	1 dump trk., 2 men	2 comp. trk.	$3,600 (1961) (includes disposal)				Open dump N. edge of Village	20 years	General Fund
Lake Angelus Village 231			Private hauler R - 1/wk			Unknown	$4.50 per/mo. per/res.				Unknown		Service Charge
Lake Orion Village 2,698			Contract R - 2/wk summer R - 1/wk winter				$7,020 (1961) (includes disposal)				Open dump 1 mi. S. of Village	Unknown	General Fund
Leonard Village 359			Contract R - 1/mo.			Unknown	$360 (1961) (includes disposal)				N. in St. Clair County	Unknown	General Fund
Milford Village 4,323		R - 1/wk	Contract R - 2/wk summer R - 1/wk winter C - By arrangement			3 comp. trk., 2 men each	$6,800 (1961) (includes disposal)			Open dump S. edge of Village	San L.F. 2 mi. N. of Village	Unknown	General Fund

TABLE IV
(continued)

MUNICIPALITY & POPULATION	COLLECTION METHODS AND AMOUNTS COLLECTED			EQUIPMENT AND CREW			COLLECTION COST		DISPOSAL METHODS			FUTURE LIFE OF SITES	HOW FINANCED
	GARBAGE	RUBBISH	COMBINED	GARBAGE	RUBBISH	COMBINED	RESIDENTIAL	COMMERCIAL	GARBAGE	RUBBISH	COMBINED		
Novi Village 6,454			Private hauler			Unknown	$1.25 - $2.00 per/mo. per/res. (includes disposal)				San L.F. within Village	Unknown	Service Charge
Orchard Lake Village 1,127	Municipal forces R - 1/wk 600 cu. yd. annually	Municipal forces R - 1/mo. 875 cu. yds. annually		1 dump trk., 2 man crew			Unknown				San. L.F. City of Pontiac $2.50 per 5 cu. yds.	Unknown	General Fund
Ortonville Village 771			Private hauler R - 2/wk summer R - 1/wk winter C - 2/wk summer C - 1/wk winter			1 comp. trk.	$34.00 per/yr. per/res. (includes disposal)	$40.00 per yr. per/establ. (includes disposal)			3/4 mi. S. of Village	Unknown	Service Charge
Oxford Village 2,357	Contract R - 1/wk summer only		Contract R - 1/wk C - 1 - 5/wk. R - 2500 cu. yds. (1961)	Unknown		Unknown	$5,800 (1961) (includes disposal)				San. L.F. 3 mi S.E. of Village	Unknown	General Fund
Quakertown Village 482		Private hauler R - 1/wk 60% R - 1/mo 40%			Unknown		Unknown			Unknown		Unknown	Service Charge

TABLE IV
(continued)

MUNICIPALITY & POPULATION	COLLECTION METHODS AND AMOUNTS COLLECTED			EQUIPMENT AND CREW			COLLECTION COST		DISPOSAL METHODS			FUTURE LIFE OF SITES	HOW FINANCED
	GARBAGE	RUBBISH	COMBINED	GARBAGE	RUBBISH	COMBINED	RESIDENTIAL	COMMERCIAL	GARBAGE	RUBBISH	COMBINED		
Rochester Village 5,431	Contract R - 2/wk summer R - 1/wk winter C - 4/wk summer C - 2/wk winter 800 cu. yds. (1961)	Municipal R - 1/wk C - 1/wk 10,000 cu. yds. (1961)		1 comp. trk.	1 comp. trk., 3 men		$24,000 (1961)		Hogfarm in Oakland Twp. 1 mi. N.	San. L.F. in Village $2,000 (1961)		Hog farm 2 years, San. L.F. 2 years	General Fund
Wolverine Lake Village 2,404			Private hauler			Unknown	$1.50 per/mo. per/res. (Includes disposal)	By arrangement (includes disposal)			San. L.F. 4 mi. N.W. in White Lake Twp.	Unknown	Service Charge
Wood Creek Farms Village 684		Contract R - 1/mo.			Unknown		$13.00 per/yr. per/res. (Includes disposal)					Unknown	General Fund
Addison Township 1,332	The Township has no collection system.										Disposal site N. in St. Clair County	Unknown	Unknown
Avon Township 15,966			Contract R - 1/wk C - By arrangement				$1.50 per/mo. per/res.	By arrangement (includes disposal)			San. L.F. E. side of Twp.	Unknown	Service Charge
Bloomfield Twp. 22,530			Private hauler R - 1/wk C - By arrangement			1 comp. trk.	$1.50 per/mo. per/res. (Includes disposal)	By arrangement			Open dump 5 mi. N.W. in Waterford Twp.	Unknown	Service Charge

TABLE IV
(continued)

MUNICIPALITY & POPULATION	COLLECTION METHODS AND AMOUNTS COLLECTED			EQUIPMENT AND CREW			COLLECTION COST		DISPOSAL METHODS			FUTURE LIFE OF SITES	HOW FINANCED
	GARBAGE	RUBBISH	COMBINED	GARBAGE	RUBBISH	COMBINED	RESIDENTIAL	COMMERCIAL	GARBAGE	RUBBISH	COMBINED		
Brandon Twp. 2,416	The Township has no collection system.										Open dump S.W. cor. of Twp.	Unknown	
Commerce Twp. 9,608			Private hauler R - 1/wk			Unknown	$1.50 per/mo. per/res. (includes disposal)				San. L.F. in White Lake Twp.	Unknown	Service Charge
Farmington Twp. 25,526		Private hauler R - 1/mo.			Unknown		$10,000 (1961) (includes disposal)			Open dump in Highland Twp.		10 years	General Fund
Groveland Twp. 1,306		Private hauler R - By arrangement			Unknown					Open dump in Brandon Twp. $500 in (1961)		Unknown	Service Charge
Highland Twp. 4,855			Private hauler R - 1/wk			2 comp. trk., 2 enclosed trk.	$1.50 per/mo. per/res. (includes disposal)				Open dump S.E. cor. of Twp.	Unknown	Service Charge
Holly Township 2,282			Private hauler R - (serves 20%)			Unknown	Unknown	Unknown			Open dump S.E. cor. of Twp.	Unknown	Service Charge
Independence Township 10,121			Private hauler			1 open trk., 1 enclosed trk.	$21.00 per/yr. per/res. (includes disposal)	$93.60 per/estab. per/yr. (includes disposal)			San. L.F. in Brandon Township	Unknown	Service Charge
Lyon Township 2,880			Private hauler R - By arrangement C - By arrangement			Unknown	Unknown	Unknown			Open dump center of Twp.	100 years	Service Charge

TABLE IV
(continued)

MUNICIPALITY & POPULATION	COLLECTION METHODS AND AMOUNTS COLLECTED			EQUIPMENT AND CREW			COLLECTION COST		DISPOSAL METHODS			FUTURE LIFE OF SITES	HOW FINANCED
	GARBAGE	RUBBISH	COMBINED	GARBAGE	RUBBISH	COMBINED	RESIDENTIAL	COMMERCIAL	GARBAGE	RUBBISH	COMBINED		
Milford Township 1,548	The Township has no collection system.										Open dump 1 mi. N. in Highland Twp.	Unknown	
Oakland Township 2,469			Private hauler R - 1/wk				$2.00 per/mo. per/res.				Open dump Orion Twp. $750 (1961)	Unknown	General Fund and Service Charge
Orion Township 9,146			Contract R - 2/wk summer C - 2/wk summer R - 1/wk winter C - 1/wk winter			2 comp. trk.					Orion-Pontiac Twp. Land-Fill Authority	Unknown	Service Charge
Oxford Township 3,206	The Township has no collection system.										Township pays $75 per mo. to Orion Twp. for use of disposal site	Unknown	General Fund
Pontiac Township 8,959			Private hauler			Unknown	Unknown	Unknown			Orion - Pontiac Twp. Land-fill Authority $500 per/yr.	Unknown	Unknown
Rose Township 1,482			Private hauler			Unknown					Open dump S.E. cor. of Twp. $600 (1961)	Unknown	Unknown

TABLE IV
(continued)

MUNICIPALITY & POPULATION	COLLECTION METHODS AND AMOUNTS COLLECTED			EQUIPMENT AND CREW			COLLECTION COST		DISPOSAL METHODS			FUTURE LIFE OF SITES	HOW FINANCED
	GARBAGE	RUBBISH	COMBINED	GARBAGE	RUBBISH	COMBINED	RESIDENTIAL	COMMERCIAL	GARBAGE	RUBBISH	COMBINED		
Royal Oak Township 8,147			Contract R - 1/wk 517 tons (1961)			Unknown	$14,251 (1961)				Incinerator (SEOCIA) $2,631 (1961)		
Springfield Township 2,664	The Township has no Collection system.								The Township has no disposal site.				
Waterford Township 47,008		Private hauler			Unknown						Open dump S.W. cor. of Twp., and San. L.F. S.W. cor. of Twp.	Unknown	Service Charge
West Bloomfield Township 13,867			Contract R - 1/wk C - By arrangement 3,600 tons (1961)				$6,000 (1961) $1.00 per/mo. per/res.	$60.00 per/yr. per/estab.			San. L.F. in S.W. Waterford Twp.	1 year	Service Charge
White Lake Township 8,381			Private hauler			Unknown	$18.00 per/yr. per/res.				San. L.F. in S. end of Twp.	2 - 5 years	

TABLE V

QUANTITIES OF INDUSTRIAL REFUSE FROM QUESTIONNAIRES and SUMMARY OF PERTINENT DATA

Item	Quantity per Calendar Day T/D	 CY/D
Garbage	27	
Combustible	537	
Non-combustible	553	
Construction Material		58
Fly Ash		82
Foundry Sand		300
Non-volatile liquid		22
Volatile liquid		62
Sludge		126

	No.
Industries operating seasonally	50
Industries doing salvage	126
Industries burning waste materials	223
Industries operating open dumps	25
Industries reporting operating sanitary landfill	17
Industries operating on-site incinerators	6

TABLE VI

ESTIMATED VEHICLE AND EQUIPMENT REQUIREMENTS

PLAN A

	TOTAL NO. REQUIRED	
	1970–1980	1980–1990
INCINERATORS		
Passenger Vehicle	3	4
1/2 Ton Pick-up Truck	3	4
6 x 9 Dump Truck	3	4
RESIDUE DISPOSA		
65,000 GVW Tractor	6 *	12 *
40 C.Y. Ash Trailer	11 *	27 *
Bull Dozer	1	1
Front Loader	1	1
Self Loading Pan - 10 C.Y.	1	1
1/2 Ton Pickup Truck	1	1
Passenger Vehicle	1	1
TRANSFER STATIONS		
65,000 GVW Tractor	13	7
80 C.Y. Side Dump Trailer	41	36
Street Sweeper	3	2
Tractor w/Bucket & Backhoe	3	2
PLAN B		
INCINERATORS		
Passenger Vehicle	2	3
1/2 Ton Pick-up Truck	2	3
6 x 9 Dump Truck	2	3
RESIDUE DISPOSAL		
65,000 GVW Tractor	3 *	6 *
40 C.Y. Ash Trailer	6 *	10 *
Bull Dozer	1	1
Front Loader	1	2
Self Loading Pan - 10 C.Y.	1	1
1/2 Ton Pick-up Truck	1	1
Passenger Vehicle	1	1
TRANSFER STATIONS		
65,000 GVW Tractor	9	12
80 C.Y. Side Dump Trailer	61	79
Street Sweeper	3	3
Tractor w/Bucket & Backhoe	3	3
COMMON TO BOTH PLANS		
ADMINISTRATIVE		
Passenger Vehicle	3	3
1/2 Ton Pick-up Truck	1	1
CONVENIENCE CENTERS		
56,000 GVW Roll-Off Chassis	4	4
Roll-Off Frame	4	4
30 C.Y. Compactor Truck	2	2
6 x 9 Dump Truck w/Lodal	8	9
40 C.Y. Roll-Off Unit	20	46
30 C.Y. Roll-Off Unit	30	26
8 C.Y. Container	37	57

* Includes spare equipment where required for adequate maintenance and service.

TABLE VII

ESTIMATED MANPOWER REQUIREMENTS

		TOTAL REQUIRED	
		1970–1980	1980–1990
ADMINISTRATIVE UNIT			
Executive		2	2
Engineers and Technicians		3	3
Secretaries and Clerks		5	5
Maintenance and Labor		7	7
	TOTAL	17	17
CONVENIENCE CENTERS			
Drivers		30	30
Helpers		26	26
	TOTAL	56	56

		TOTAL REQUIRED		TOTAL REQUIRED	
		1970–1980	1980-1990	1970–1980	1980–1990
		PLAN A		PLAN B	
INCINERATORS					
Drivers		12	16	8	12
Crane Operators		24	32	16	24
Tipping Floor Attendant		3	4	2	3
Scale Attendant		12	16	8	12
Superintendent		3	4	2	3
Shift Engineer		12	16	8	12
Boiler Engineer		12	16	8	12
Firemen		56	76	44	72
Electricians		6	8	4	6
Mechanics		6	8	4	6
Laborers		18	12	6	15
Janitors		9	12	6	9
	TOTAL	173	220	116	186
TRANSFER STATIONS					
Drivers		52	24	18	24
Floor Attendants		10	6	6	6
Scale Attendants		10	6	6	6
Laborers		10	6	6	6
Equipment Operators		10	6	6	6
	TOTAL	92	48	42	48
RESIDUE DISPOSAL					
Drivers		20	33	10	20
Laborers		2	2	2	2
Landfill Foremen		1	1	1	1
Equipment Operators		6	8	4	8
	TOTAL	29	44	17	31
	GRAND TOTAL	367	385	269	362

TABLE VIII

ESTIMATED UNIT PRICES OF VEHICLES & EQUIPMENT IN 1970 *

ITEM	UNIT	UNIT COST
Passenger Vehicle	Each	$ 3,000.
1/2 Ton Pick-up Truck	Each	3,500.
65,000 GVW Tractor	Each	17,500.
40 C.Y. Ash Trailer	Each	8,500
80 C.Y. Side Dump Trailer	Each	21,000.
Roll-Off Frame	Each	5,800.
55,000 GVW Roll-Off Chassis	Each	15,200.
30 C.Y. Compactor Truck	Each	29,000.
6 x 9 Dump Truck	Each	8,000.
Lodal Brush & Scoop	Each	3,600.
40 C.Y. Roll-Off Unit	Each	3,500.
30 C.Y. Roll-Off Unit	Each	3,200.
8 C.Y. Roll-Off Unit	Each	600.
Front Loader	Each	45,000.
10 C.Y. Self Loading Pan	Each	80,000.
Bull Dozer	Each	40,000.
Street Sweeper	Each	12,000.
Tractor with Bucket and Backhoe	Each	6,000.
Scale	Each	
Fence	L.F.	3.
Landscaping	Ac.	1,000.
Onsite Roadway	S.Y.	4.
Access Road Construction	L.F.	10.
Access Road Resurfacing	L.F.	3.30

* 1980 unit costs may be determined from 1970 prices increased by 1.411

TABLE IX

TYPICAL TRANSFER STATION COST

Land	$ 9,000.
Earthwork	2,000.
Concrete Substructure & Foundation	22,700.
Superstructure	67,600.
Paving & Utilities	30,000.
Fencing & Landscaping	6,000.
Scale & Pit	25,000.
	$ 162,300.
Engineering & Contingencies	32,500.
	$ 194,800.

TABLE X

TYPICAL CONVENIENCE CENTER COST

Land	$ 2,000.
Earthwork	1,000.
Concrete Substructure	6,400.
Superstructure	11,600.
Paving & Utilities	3,000.
Fencing & Landscaping	3,200.
	$ 27,200.
Engineering & Contingencies	5,400.
	$ 32,600.

TABLE XI

ESTIMATE OF COST FOR SEPTIC TANK SLUDGE INCINERATION EQUIPMENT

Excavation	$ 11,000.
Evaporating Pans & Foundations	235,000.
Greenhouse	120,000.
Equipment	103,900.
Electrical	15,000.
	$ 484,900.
Engineering & Contigencies	97,000.
	$ 581,900.

TABLE XII

COST OF STEAM LINE TO OAKLAND UNIVERSITY

Land Acquisition	$ 45,000.
Excavation	22,300.
Conduit	364,000.
Steam Pipe & Insulation	404,600.
Equipment	14,100.
	$ 850,000.
Engineering & Contigencies	170,000.
	$1,020,000.

TABLE XIII

OAKLAND COUNTY EQUALIZED VALUATION

Year	Equalized Valuation	% of Increase	
1948	$ 560,000,000.		
1949	576,300,000.	2.91%	
1950	592,012,185.	2.73	5.72
1951	709,400,000	19.83	26.68
1952	774,315,000.	9.15	38.27
1953	845,071,000.	9.14	50.91
1954	966,608.754.	14.38	72.61
1955	1,395,250,000.	44.34	149.15
1956	1,584,801,899.	13.59	183.00
1957	1,673,313,271.	5.59	198.80
1958	1,808,669,648.	8.09	222.97
1959	1,822,915,328.	0.79	225.52
1960	1,893,302,301.	3.86	238.09
1961	2,094,683,180.	10.64	274.05
1962	2,112,408,200.	8.46	277.22
1963	2,202,625,500.	4.27	293.33
1964	2,313,884,200.	5.05	313.19
1965	2,447,383,400.	5.77	337.03
1966	2,689,070,738.	9.88	380.19
1967	3,034,706,025.	12.85	441.91
1968	3,460,371,031.	14.03	517.92

TABLE XIV

ACTIVE DISPOSAL SITES IN OAKLAND COUNTY

DECEMBER, 1967

ADDISON TOWNSHIP	
Mack Road between Texter & Townsend	
AVON TOWNSHIP	
1741 School Road	SEOCIA operated
School Road	Construction Debris
2751 Hamlin Road	Veteran's Disposal Service
BRANDON TOWNSHIP	
M-15 1/4 mile N. Township Line -	County Road Commission
COMMERCE TOWNSHIP	
Maple behind Sterling Garrett	
Welch behind McEvoy Door Co.	
Ladd Road near Lakeside Market	
HIGHLAND TOWNSHIP	
3100 Teeple Lake Road	Robinson Disposal Service
3200 Teeple Lake Road	Willard Sanitation Service
Reid Road 1/8 mile east Milford Road	
HOLLY TOWNSHIP	
Falk Road	Village of Holly
Quick Road just west of Fagan	
INDEPENDENCE TOWNSHIP	
6440 Orion Road	Ben Powell Disposal
5380 Center Street	Dervage Disposal
LYON TOWNSHIP	
11 Mile Road 1/4 mile east of Martindale	
MILFORD TOWNSHIP	
Old Plank Road at S. Village Limits -	Milford Township
Milford Road 1/2 mile north Buno	
NOVI TOWNSHIP	
50250 8 Mile Road	Munn Contracting
Taft Road near Northville Village Limit	
OAKLAND TOWNSHIP	
Rochester Road	Nunn Piggery
ORION TOWNSHIP	
1350 Kern Road	Pontiac-Orion Authority
Clarkston Road 1/4 mile west N.Y.C. R.R.	
Greenshield Road 1/4 mile west Kern Road - Highland Rec. Area	
Bald Mountain Road at Dutton Road	
OXFORD TOWNSHIP	
M-24 between Metamora and Dunlap Roads	

PONTIAC TOWNSHIP	
Bald Mountain Road at Dutton Road	County Road Commission
Joslyn Road south Taylor	Industrial Services of America
Kennett Road at G.T. R.R.	City of Pontiac
Auburn Road 1/8 mile east Opdyke	
ROSE TOWNSHIP	
2375 East Rose Center Road	Marlow & Sons Disposal
ROYAL OAK TOWNSHIP	
John R 1/4 mile north 12 Mile Rd.	SEOCIA Incinerator
SOUTHFIELD TOWNSHIP	
J. L. Hudson Dr. across from Northland	Construction Materials
SPRINGFIELD TOWNSHIP	
Eaton Road 1/2 mile north Davisburg Road	
WATERFORD TOWNSHIP	
M-59 at Cass Lake Road	Construction Materials
WHITE LAKE TOWNSHIP	
9941 Cedar Island Road	Chapel Disposal

TABLE XV

IMPROPERLY CLOSED and INACTIVE SITES
DECEMBER, 1967

BLOOMFIELD TOWNSHIP
  Kemp - East End

FARMINGTON TOWNSHIP
  10 Mile Road - 1/2 mile east of Drake

NOVI TOWNSHIP
  13 Mile Road - 1/2 mile east of Novi Road
  Liuhart Street- 1/8 mile east of Novi Road

OXFORD TOWNSHIP
  Lakeville Road east of Village Limit

ROSE TOWNSHIP
  Demode Road 1/2 mile west Buckhorn Lake Road

WATERFORD TOWNSHIP
  Cooley Lake Road 1/4 mile East Hospital Road
  Letart Street West End 1/2 mile N. Walton
  Rockcroft South End - building material

WEST BLOOMFIELD
  Willow Road 1/8 mile S. Hiller
  Halstead Road 1/8 mile S. G.T. R.R.

WHITE LAKE TOWNSHIP
  4914 Cedar Island Road

IMPLEMENTING PROCEDURE

The work proposed in this Report will require much coordination of activity to implement recommendations. These recommendations are based on a County-wide operation for refuse disposal facilities. Michigan law requires contracts assigning authority for refuse disposal to the County before these recommendations can become a reality.

The following list indicates the procedure that is suggested to implement the program.

1. Present report to the County Board of Supervisors.
2. Study report and recommendations by the County Board of Supervisors.
3. Present the Report to the Southeastern Oakland County Incinerator Authority for their study.
4. A meeting between the Board of Supervisors and the Directors of the Southeastern Oakland County Incinerator Authority to determine which plan will be followed.
5. Authorization from the County Board of Supervisors to the County agency to proceed with the recommended project.
6. Obtain limited contracts from cities, villages and townships.
7. Locate land for the construction of facilities and obtain options or purchase outright.
8. Make necessary soil investigations.
9. Prepare engineering plans and specifications for construction of facilities.
10. Establish rates.
11. Obtain firm contracts from cities, villages and townships.
12. Engage financial consultants to review financing procedure.
13. Supervisors approve bond issues.
14. Finance commission approves bond issue.
15. Sell bonds. Advertise for bids on construction to implement the program.
16. Award contracts.
17. Hire supervisory operating personnel to observe construction of facilities.
18. Complete construction, test equipment, and begin service.
19. Certify rates to be collected under the agreements to the County fiscal officer for collection.

SOLID WASTE DEFINITIONS

ABANDONED VEHICLES
Passenger automobiles, buses, trucks, motorcycles, farm implements and trailers that are no longer useful as such and have been left elswhere than a recognized junk yard or auto destructor.

AIR POLLUTION CONTROL DEVICE
Equipment for removing fly ash, particulates, and some gaseous or chemical products of combustion from the stack effluent prior to release to the atmosphere. Such equipment may be electrostatic precipitators or high efficiency wet scrubbers.

ASHES
Residue from the burning of wood, coal, coke, or other combustible materials.

AUXILIARY FUEL FIRING EQUIPMENT
Equipment to supply additional heat, by the combustion of an auxiliary fuel, for the purpose of attaining temperatures sufficiently high (a) to dry and ignite the waste material, (b) to maintain ignition thereof, and (c) to promote complete combustion of combustible solids, vapors and grease.

BAFFLE
Any refractory construction intended to change the direction of flow on the products of combustion.

BREECHING (FLUE CONNECTION)
A passage for conducting the products of combustion to the stack or chimney.

BTU (BRITISH THERMAL UNIT)
The quantity of heat required to increase the temperature of one pound of water from 60 degrees to 61 degrees F.

BULKY WASTE
Large items of refuse such as appliances, furniture, large auto parts, trees and branches, large containers, rubber tires, etc.

BURNER
A device for either municipal or on-site volume reduction of refuse by burning, and of simple construction. Not to be confused with an incinerator, which, properly designed and operated, can produce an acceptable emission and residue.

BURNING AREA (INCINERATOR)
The horizontal projected area of grate, hearth, or the combination where burning takes place.

BURNING RATE
The amount of waste consumed, usually expressed as pounds per hour per square foot of burning area. Occasionally expressed as BTU per hour per square foot of burning area, which refers to the heat liberated by combustion of the waste.

BYPASS
An arrangement of breechings or flue connections and dampers to permit the alternate use of two or more pieces of equipment by directing or diverting the flow of the products of combustion.

CAPACITY RATED

The theoretical amount of solid, semi-solid, gaseous or liquid wastes that can be burned to an inoffensive residue containing little or no combustible material, and/or as gaseous by-product in a given time period usually expressed in pounds per hour or tons per day.

CELL

Compacted refuse completely surrounded by cover material.

CENTRAL GARBAGE GRINDING

The mechanical grinding of garbage accumulated by municipal, commercial, or private delivery vehicles.

CHIMNEY

See STACK.

CHUTE, CHARGING (INCINERATOR)

A pipe or duct through which wastes are conveyed from above to the primary chamber.

COMBUSTIBLE RUBBISH

Miscellaneous burnable materials. In general, the organic component of rubbish.

COMBUSTION AIR (THEORETICAL)

Air, calculated from the chemical composition of waste, required to burn the waste completely without additional air. Also designated as stoichiometric air.

COMBUSTION AIR (EXCESS)

Air supplied in excess of theoretical air, usually expressed as a percentage of the theoretical air. Also called excess air.

COMBUSTION CHAMBER

Chamber where ignition and burning of the waste occur.

COMMERCIAL REFUSE

All solid wastes which originate from a business such as office buildings, stores, markets, theaters and privately and publicly owned hospitals and other institutional buildings.

COMMUNICABLE DISEASE

All illness due to an infectious agent or its toxic products which is transmitted directly or indirectly to a well person from an infected person or animal, or through the agency of an intermediate host, vector, or inanimate environment.

COMPACTOR TRUCK

Enclosed vehicle provided with special mechanical devices for loading the refuse into the main compartment of the body, compressing the loaded materials, and distributing the refuse within the body.

COMPOSTING

A controlled biological degradation of organic waste yielding a nuisance-free product of potential value as a soil conditioner.

CONSTRUCTION AND DEMOLITION WASTES

Waste building materials and rubble resulting from construction, remodeling, repair, and demolition operations on houses, commercial buildings, pavements, and other structures.

CONTAMINATION

Presence of a pathogenic organism on a body surface, or on or in an inanimate article.

CONTRACT COLLECTION

An arrangement whereby the city pays a contractor for doing collection work.

DEAD ANIMALS

Those that die naturally, from disease or are accidentally killed. Condemned animals or parts of animals from slaughter houses or similar places are not included in this term, but are regarded as industrial refuse.

DEMOLITION WASTES

See CONSTRUCTION AND DEMOLITION WASTES.

DISINFECTION

Killing of pathogenic agents outside the body by chemical or physical means directly applied.

DISPOSAL AREA

A site, location, tract of land, area, building, structure or premises used or intended to be used for partial and/or total refuse disposal.

DOMESTIC REFUSE

All those types of solid waste which normally originate in the residential household or apartment house.

DRAFT

The pressure difference between the incinerator, or any component part, and the atmosphere, which causes the products of combustion to flow from the incinerator to the atmosphere.

—Natural: The negative pressure created by the difference in density between the hot flue gases and the atmosphere.

—Induced: The negative pressure created by the action of a fan, blower or ejector located between the incinerator and the stack.

—Forced: The positive pressure created by the action of a fan or blower, supplying the primary or secondary air.

DRYING HEARTH

A surface within the primary chamber upon which wet waste material is depositied for drying, prior to burning.

DUMP

See OPEN DUMP.

EMISSION

The gases, vapor, and particulates that reach the atmosphere from the burning process.

EXCESS AIR

The air remaining after a fuel has been completely burned, or that air supplied in addition to the theoretical quantity.

FLUE

See STACK.

FLUE GAS WASHER OR SCRUBBER

Equipment for removing fly ash and other objectionable materials from the products of combustion by means of sprays, wet baffles, etc. Also reduces the temperature of effluent gases.

FLY ASH

All solids including ash, charred paper, cinders, dusty soot or other partially incinerated matter, carried by the gaseous products of combustion.

FLY ASH COLLECTOR

Equipment for trapping and removing fly ash from the products of combustion.

GARBAGE

Rejected food wastes including waste accumulation of animal, fruit or vegetable matter used or intended for food or that attend the preparation, use, cooking, dealing in or storing of meat, fish, fowl, fruit or vegetable.

GARBAGE GRINDING

A method of uniformly reducing food waste or garbage and placing the reduced product in sewer systems. The reducing device may be a home sink grinder, or a large central grinder which serves industry or the community. It is noted that the ground garbage, which should pass through a sewage treatment plant, must still be disposed of as sewage sludge after treatment.

GASES, INCINERATOR

Combustion gases which may contain water vapor and excess or dilution air added after the combustion chamber.

GRATE

Surface with suitable openings, to support the refuse and permit passage of air through the burning fuel. It is usually located in the primary combustion chamber, and is designed to permit movement of unburned refuse or residue, and may be horizontal or inclined and stationary or movable.

GROUND WATER

Water in the ground that is in the zone of saturation.

HAZARDOUS WASTES

Includes, but is not limited to, explosives, pathological wastes, radioactive materials and chemicals.

HEAT EXCHANGER

A device for transferring heat from one medium to another by conduction through a third material. In a boiler, the processes whereby hot gases pass over waterfilled metal tubes, to cool the gases and to convert the water to steam.

HEAT OF COMBUSTION

The amount of heat, usually expressed as BTU per pound of as-fired or dry waste, liberated by combustion at a reference temperature of 68 degrees F. With reference to auxiliary gas, it is expressed as BTU per standard cubic foot, and to auxiliary oil as BTU per pound or gallon. Also called heating value.

HEAT RELEASE RATE

The amount of heat liberated in the primary combustion chamber, usually expressed as BTU per hour per cubic foot.

INCINERATION

An arrangement of chambers and equipment designed for burning solid, semi-solid, liquid or gaseous combustible waste to an inoffensive gas and a residue containing little or no combustible material.

INDUSTRIAL REFUSE

All solid wastes which result from industrial processes and manufacturing operations such as factories, processing plants, repair and cleaning establishments, refineries and rendering plants.

JUNK

A collection of secondary materials, sorted but unprocessed.

MUNICIPAL COLLECTION

An arrangement whereby the city pays the collection personnel and operation is by city departments.

NONCOMBUSTIBLE RUBBISH

Miscellaneous refuse materials that are unburnable at ordinary incinerator temperatures (1300 degrees F to 2000 degrees F).

ON-SITE DISPOSAL

Includes all means of disposal or volume reduction of refuse on premises before collection. Examples are garbage grinding; burning or incineration; burial; compaction; or slurrying at homes and commercial establishments.

OPEN DUMP

The consolidation of waste from one or more sources at a central disposal site which has little or no management. Some of the problems associated with open dumps are: vector breeding, air pollution, water pollution, unsightliness, wasted land, disease and accident potentials.

PARTICULATE MATTER

Any liquid or any solid which is so finely divided as to be capable of becoming windblown or being suspended in air or gas.

PATHOGEN

Any infective agent capable of producing disease.

PRIVATE COLLECTION

An arrangement whereby citizens or firms, individually or in limited groups, pay collectors or private operating agencies for removing refuse.

PUTRESCIBLE

Capable of being decomposed by microorganisms with sufficient rapidity to cause nuisances from odors, gases, etc. Kitchen wastes, offal, and dead animals are examples of putrescible components of solid waste.

REFUGE

A hiding place or shelter for rats, mice and insects. It is important to distinguish between refuge and refuse. Refuse means solid waste. The confusion comes about because refuse frequently serves as a refuge for vermin.

REFUSE
Putrescible and nonputrescible solid wastes, except body wastes. Includes garbage, rubbish, ashes, incinerator residue, street cleanings and solid market and industrial wastes.

REFUSE SHED
A region or area which for reasons of topography, contiguous population and/or other common features, includes refuse sources which may be considered collectively in general planning. Usually synonymous with the general populated or metropolitan area, and not necessarily limited by lines of political jurisdiction.

RESIDUE
Solid materials remaining after burning, comprising ash, metal, glass, ceramics, and unburned organic substances.

RINGELMANN CHART
A printed or photographically reproduced series of four shades of gray, by which density of smoke emissions from an incinerator may be estimated. A clear stack is recorded as 0, and 100% black smoke as 5. No. 1 smoke is 20% dense; No. 2, 40% dense; No. 3, 60% dense; No. 4, 80% dense.

RUBBISH
Nonputrescible solid wastes. Includes ashes of both combustible and noncombustible wastes, such as paper, cardboard, tin cans, yard clippings, wood, glass, bedding, crockery, or litter of any kind.

SALVAGING
The controlled removal of reusable materials.

SANITARY LANDFILL
A method of disposing of refuse on land without creating nuisances or hazards to public health or safety, by utilizing the principles of engineering to confine the refuse to the smallest practical area, to reduce it to the smallest practical volume and to cover it with a layer of earth at the conclusion of each day's operation or at more frequent intervals if necessary.

SCAVENGING
The uncontrolled picking of materials in a disposal area, usually associated with an open dump.

SEWAGE TREATMENT RESIDUES
Coarse screenings, grit, and dewatered or air-dried sludge from sewage treatment plants, and pumpings of cesspool or septic tank sludges, which require disposal with municipal solid wastes.

SPECIAL WASTES
Hazardous wastes by reason of their pathological, explosive, radioactive or toxic nature.

STACK (CHIMNEY, FLUE)
A vertical passage for conducting products of combustion to the atmosphere.

STERILIZATION
Destruction of all microorganisms and their spores outside the body by chemical or physical means.

STOICHIOMETRIC AIR
See COMBUSTION AIR, THEORETICAL.

STREET REFUSE

Material picked up by manual and mechanical sweeping of streets and sidewalks, litter from public receptacles, and dirt removed from catch basins.

SURFACE WATER

A body of water whose top surface is exposed to the atmosphere, including a flowing body as well as a pond or lake.

SWILL

Semi-liquid waste material consisting of garbage and free liquids.

THEORETICAL AIR

The exact amount of air required to supply oxygen for complete combustion of a given quantity of a specific fuel.

TONS PER DAY (INCINERATION)

Denotes the weight of refuse which can be properly processed by an incinerator within a 24 hour period. (See Capacity, rated)

TRANSFER STATION

A supplemental transportation system as an adjunct to route collection vehicles to reduce haul costs or add flexibility to the operation. A typical system has facilities in which route vehicles empty into a large hopper, from which open semi-trailers of about 80 cubic yards capacity or railroad cars are filled. There may be some recompaction of refuse.

VECTOR (OF DISEASE)

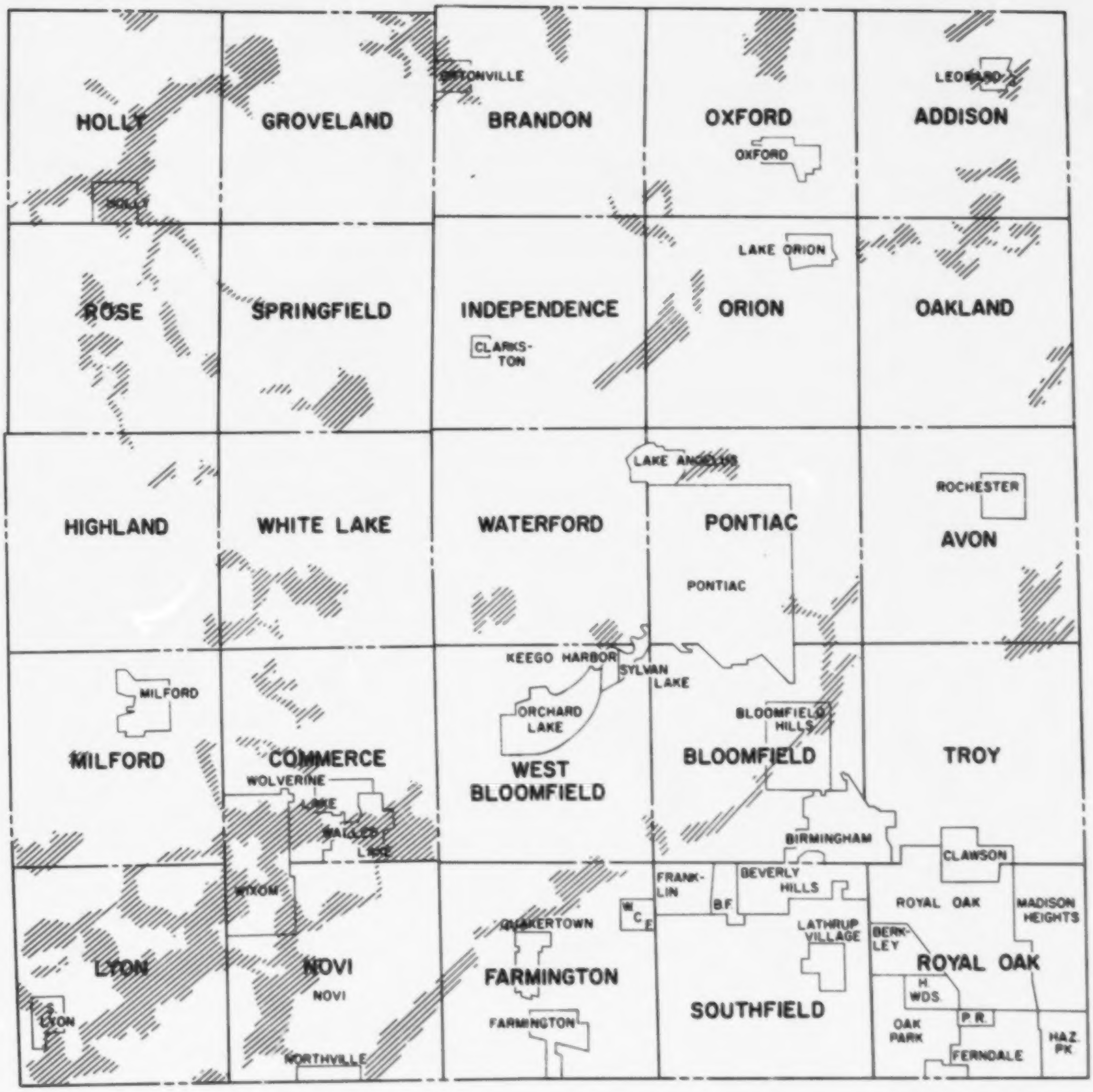
A living insect or other arthropod, or animal (not human) which transmits infectious diseases from one person or animal to another.

WASTE

Useless, unwanted, or discarded materials resulting from normal community activities. Wastes include solids, liquids, and gases. Solid wastes are classed as refuse.

YARD RUBBISH

Prunings, grass clippings, weeds, leaves, and general yard and garden wastes.


HOLLY
GROVELAND
ORTONVILLE
BRANDON
OXFORD
ADDISON
LEONARD
OXFORD
HOLLY
ROSE
SPRINGFIELD
INDEPENDENCE
LAKE ORION
ORION
OAKLAND
CLARKS-TON
HIGHLAND
WHITE LAKE
WATERFORD
LAKE ANGELUS
PONTIAC
ROCHESTER
AVON
PONTIAC
KEEGO HARBOR
SYLVAN LAKE
MILFORD
ORCHARD LAKE
BLOOMFIELD HILLS
MILFORD
COMMERCE
WEST BLOOMFIELD
BLOOMFIELD
TROY
WOLVERINE LAKE
WALLED LAKE
BIRMINGHAM
CLAWSON
WIXOM
FRANK-LIN
B.F.
BEVERLY HILLS
ROYAL OAK
MADISON HEIGHTS
W C F
QUAKERTOWN
LATHRUP VILLAGE
BERK-LEY
LYON
NOVI
NOVI
FARMINGTON
ROYAL OAK
H. WDS.
SOUTHFIELD
LYON
FARMINGTON
P.R.
OAK PARK
HAZ. PK.
NORTHVILLE
FERNDALE

B.F. = BINGHAM FARMS
H. WDS. = HUNTINGTON WOODS
HAZ. PK. = HAZEL PARK
P.R. = PLEASANT RIDGE
W.C.F. = WOOD CREEK FARMS

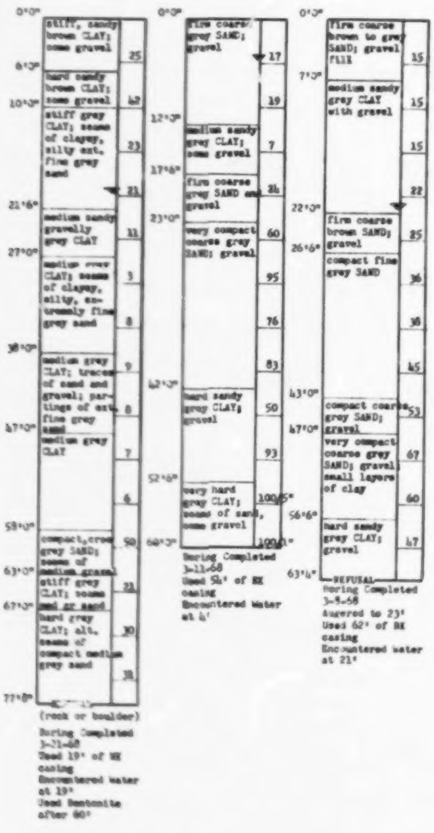
▨ UNSUITABLE LAND FOR REFUSE DISPOSAL

LAND AREAS NOT SUITABLE FOR LANDFILL OPERATIONS

F 206-1 10 PADS

TEST BORING REPORT
RAYMOND
CONCRETE PILE DIVISION
RAYMOND INTERNATIONAL INC

To Jones and Henry Date 2 April, 1968
Location of Borings Proposed Incineration Sites, Oakland County, Michigan
All borings are plotted to a scale of 1" = 8 ft. using Ground Surface Only as a fixed datum.
Boring No. ______ Boring No. AV-1 Boring No. I-2 Boring No. I-1



0'0"
stiff, sandy brown CLAY; some gravel
25
6'0"
hard sandy brown CLAY; some gravel
42
10'0"
stiff grey CLAY; seams of clayey, silty ext. fine grey sand
23
21
21'6"
medium sandy gravelly grey CLAY
11
27'0"
medium grey CLAY; seams of clayey, silty, extremely fine grey sand
3
8
38'0"
medium grey CLAY; traces of sand and gravel; partings of ext. fine grey sand
9
8
47'0"
medium grey CLAY
7
6
58'0"
compact, crse grey SAND; seams of medium gravel
50
63'0"
stiff grey CLAY; seams md gr sand
21
67'0"
hard grey CLAY; alt. seams of compact medium grey sand
30
31
77'8"
REFUSAL (rock or boulder)
Boring Completed 3-21-68
Used 19' of NX casing
Encountered water at 19'
Used Bentonite after 60'
0'0"
firm coarse grey SAND; gravel
17
19
12'0"
medium sandy grey CLAY; some gravel
7
17'6"
firm coarse grey SAND and gravel
24
23'0"
very compact coarse grey SAND; gravel
60
95
76
83
42'0"
hard sandy grey CLAY; gravel
50
93
52'6"
very hard grey CLAY; seams of sand, some gravel
100/5"
60'0"
100/1"
Boring Completed 3-11-68
Used 54' of NX casing
Encountered Water at 4'
0'0"
firm coarse brown to grey SAND; gravel FILL
15
7'0"
medium sandy grey CLAY with gravel
15
15
22
22'0"
firm coarse brown SAND; gravel
25
26'6"
compact fine grey SAND
36
38
45
43'0"
compact coarse grey SAND; gravel
53
47'0"
very compact coarse grey SAND; gravel; small layers of clay
67
60
56'6"
hard sandy grey CLAY; gravel
47
63'4"
REFUSAL
Boring Completed 3-9-68
Augered to 23'
Used 62' of NX casing
Encountered water at 21'

DRILLER: J. Pugh DRILLER: C. Pierson DRILLER: C. Pierson

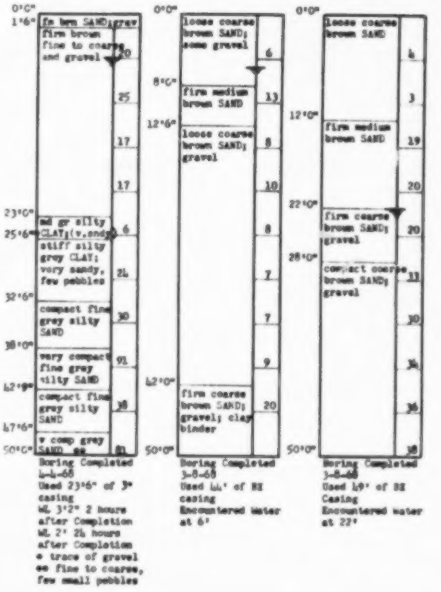
Classifications are made by visual inspection.
Water levels (WL). Figure indicates time of reading (hours) after completion of boring. Water levels indicated are those observed when borings were made, or as noted. Porosity of the soil strata, variations of rainfall, site topography, etc., may cause changes in these levels.
Figures in right hand column indicate number of blows required to drive 2" O.D. sampling pipe one foot, using 140 lb. weight falling 30 inches.

Total Footage ______
Foreman See bottom of logs
Job No. ECB-13997-D
Classification by Foreman
Sheet 4 of 7

F 206-1 10 PADS

TEST BORING REPORT
RAYMOND
CONCRETE PILE DIVISION
RAYMOND INTERNATIONAL INC

To Jones and Henry Date 8 April, 1968
Location of Borings Proposed Incineration Sites, Oakland County, Michigan
All borings are plotted to a scale of 1" = 8 ft. using Ground Surface Only as a fixed datum.
Boring No. ______ Boring No. W-2 Boring No. W-1 Boring No. H-1



0'0"
1'6"
fn brn SAND; grav
firm brown fine to coarse and gravel
20
25
17
17
23'0"
md gr silty CLAY; (v. sndy)
6
25'6"
stiff silty grey CLAY; very sandy, few pebbles
24
32'6"
compact fine grey silty SAND
30
38'0"
very compact fine grey silty SAND
91
42'9"
compact fine grey silty SAND
38
47'6"
v comp grey SAND
81
50'0"
Boring Completed 4-4-68
Used 23'6" of 3" casing
WL 3'2" 2 hours after Completion
WL 2' 24 hours after Completion
trace of gravel
fine to coarse, few small pebbles
0'0"
loose coarse brown SAND; some gravel
6
8'0"
firm medium brown SAND
13
12'6"
loose coarse brown SAND; gravel
8
10
8
7
7
9
42'0"
firm coarse brown SAND; gravel; clay binder
20
50'0"
Boring Completed 3-8-68
Used 44' of NX casing
Encountered water at 6'
0'0"
loose coarse brown SAND
4
3
12'0"
firm medium brown SAND
19
20
22'0"
firm coarse brown SAND; gravel
20
28'0"
compact coarse brown SAND; gravel
33
30
34
36
50'0"
38
Boring Completed 3-8-68
Used 49' of NX Casing
Encountered water at 22'

Driller: B. Singleton Driller: C. Pierson Driller: C. Pierson

Classifications are made by visual inspection.
Water levels (WL). Figure indicates time of reading (hours) after completion of boring. Water levels indicated are those observed when borings were made, or as noted. Porosity of the soil strata, variations of rainfall, site topography, etc., may cause changes in these levels.
Figures in right hand column indicate number of blows required to drive 2" O.D. sampling pipe one foot, using 140 lb. weight falling 30 inches.

Total Footage ______
Foreman See bottom of logs
Job No. ECB-13997-D
Classification by Foreman
Sheet 3 of 7

F 206-1 5M 8/65

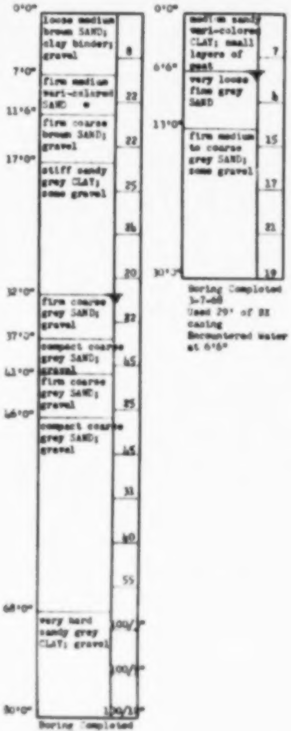
TEST BORING REPORT
RAYMOND
CONCRETE PILE DIVISION
RAYMOND INTERNATIONAL INC

To Jones and Henry Date 3 April, 1968

Location of Boring Proposed Incineration Sites, Oakland County, Ohio

All borings are plotted to a scale of 1" = 8 ft. using Ground Surface Only as a fixed datum.

Boring No. ____ Boring No. F-1 Boring No. S-1 Boring No. ____



0'0"
loose medium brown SAND; clay binder; gravel
8
7'0"
firm medium vari-colored SAND
22
11'6"
firm coarse brown SAND; gravel
22
17'0"
stiff sandy grey CLAY; some gravel
25
34
20
32'0"
firm coarse grey SAND; gravel
32
37'0"
compact coarse grey SAND; gravel
45
41'0"
firm coarse grey SAND; gravel
35
46'0"
compact coarse grey SAND; gravel
45
31
40
55
68'0"
very hard sandy grey CLAY; gravel
100/3"
100/4"
80'0"
100/10"
0'0"
medium sandy vari-colored CLAY; small layers of peat
7
6'6"
very loose fine grey SAND
4
11'0"
firm medium to coarse grey SAND; some gravel
15
17
21
30'0"
19

Boring Completed 3-5-68
Used 74' of NX casing
WL 32'

Boring Completed 3-7-68
Used 29' of NX casing
Encountered water at 6'6"

Classifications are made by visual inspection.
Water levels (WL). Figure indicates time of reading (hours) after completion of boring. Water levels indicated are those observed when borings were made, or as noted. Porosity of the soil strata, variations of rainfall, site topography, etc., may cause changes in these levels.
Figures in right hand column indicate number of blows required to drive 2" O.D. sampling pipe one foot, using 140 lb. weight falling 30 inches.

Total Footage ____
Foreman C. F. Pierson
Job No. SCB-13937-C
Classification by Foreman
Sheet 1 of 1

F 206-1 5M 8/65

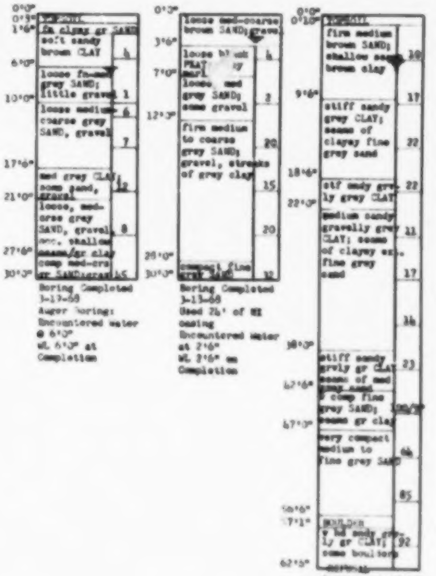
TEST BORING REPORT
RAYMOND
CONCRETE PILE DIVISION
RAYMOND INTERNATIONAL INC

To Jones and Henry Date 2 April, 1968

Location of Boring Proposed Incineration Sites, Oakland Co., Michigan

All borings are plotted to a scale of 1" = 9 ft. using Ground Surface Only as a fixed datum.

Boring No. ____ Boring No. A-1 Boring No. GB-1 Boring No. GA-1



0'0"
0'9"
1'6"
TOPSOIL
fn clayey gr SAND
soft sandy brown CLAY
4
6'0"
loose fn-med grey SAND; little gravel
1
10'0"
loose medium coarse grey SAND, gravel
6
7
17'6"
med grey CLAY; some sand, gravel
12
21'0"
loose, med-crse grey SAND, gravel, occ. shallow seams/gr clay
8
27'6"
comp med-crs gr SAND, gravel
30'0"
45
0'3"
loose med-coarse brown SAND; gravel
3'6"
loose black PEAT ... marl
4
7'0"
loose, med grey SAND; some gravel
2
12'0"
firm medium to coarse grey SAND; gravel, streaks of grey clay
20
15
20
28'0"
compact fine grey SAND
30'0"
32
0'0"
0'10"
TOPSOIL
firm medium brown SAND; shallow seams brown clay
10
9'6"
17
stiff sandy grey CLAY; seams of clayey fine grey sand
22
18'6"
stf sndy grvly grey CLAY
22
22'0"
medium sandy gravelly grey CLAY; seams of clayey ex. fine grey sand
11
17
34
38'0"
stiff sandy grvly gr CLAY seams of med comp sand
23
42'6"
v comp fine grey SAND; seams gr clay
100/9"
47'0"
very compact medium to fine grey SAND
64
85
56'6"
57'1"
BOULDER
v hd sndy grvly gr CLAY; some boulders
92
62'5"
REFUSAL (rock or boulder)

Boring Completed 3-17-68
Auger Boring;
Encountered water @ 6'0"
WL 6'0" at Completion

Boring Completed 3-13-68
Used 24' of NX casing
Encountered water at 2'6"
WL 2'6" on Completion

Boring Completed 3-22-68
Augered to 45'
(WL 1'10" 72 hrs)
Used 60' of NX Casing
Encountered water at 4'6"
WL on Completion, used Jell

Classifications are made by visual inspection.
Water levels (WL). Figure indicates time of reading (hours) after completion of boring. Water levels indicated are those observed when borings were made, or as noted. Porosity of the soil strata, variations of rainfall, site topography, etc., may cause changes in these levels.
Figures in right hand column indicate number of blows required to drive 2" O.D. sampling pipe one foot, using 140 lb. weight falling 30 inches.

Total Footage ____
Foreman J. Fisk
Job No. SCB-13997-C
Classification by Foreman
Sheet 3 of 3

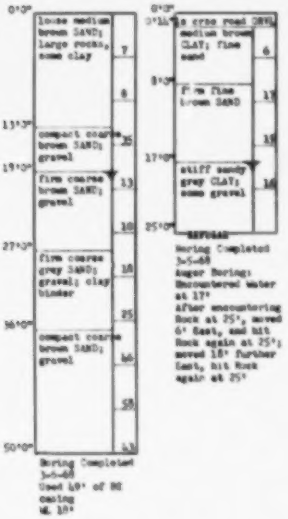
TEST BORING REPORT
RAYMOND
CONCRETE PILE DIVISION

To Jones and Henry Date 3 April, 1968 Job No. ECA-13997-C

Location of Borings Proposed Incineration Sites, Oakland County, Michigan

All borings are plotted to a scale of 1" = 8 ft. using Ground Surface Only as a fixed datum.

No. ______ No. B-1 No. B-1 No. ______



0'0"
loose medium brown SAND; large rocks, some clay
7
8
13'0"
compact coarse brown SAND; gravel
25
19'0"
firm coarse brown SAND; gravel
13
10
27'0"
firm coarse grey SAND; gravel; clay binder
18
25
36'0"
compact coarse brown SAND; gravel
46
58
43
50'0"
0'0"
0'11"
6 crse road GRVL
medium brown CLAY; fine sand
6
8'0"
firm fine brown SAND
17
19
17'0"
stiff sandy grey CLAY; some gravel
16
25'0"
REFUSAL

Boring Completed
3-5-68
Used 49' of NX casing
WL 19'

Boring Completed
3-5-68
Auger Boring:
Encountered Water at 17'
After encountering Rock at 25', moved 6' East, and hit Rock again at 25'; moved 18' further East, hit Rock again at 25'

Classifications are made by visual inspection.

Water levels (WL). Figure indicates time of reading (hours) after completion of boring. Water levels indicated are those observed when borings were made, or as noted. Porosity of the soil strata, variations of rainfall, site topography, etc., may cause changes in these levels.

Figures in right hand column indicate number of blows required to drive 2" O.D. sampling pipe one foot, using 140-lb. weight falling 30 inches.

Total Footage ______
Foreman C. Pierson
Classifications by Foreman
Sheet 1 of 1